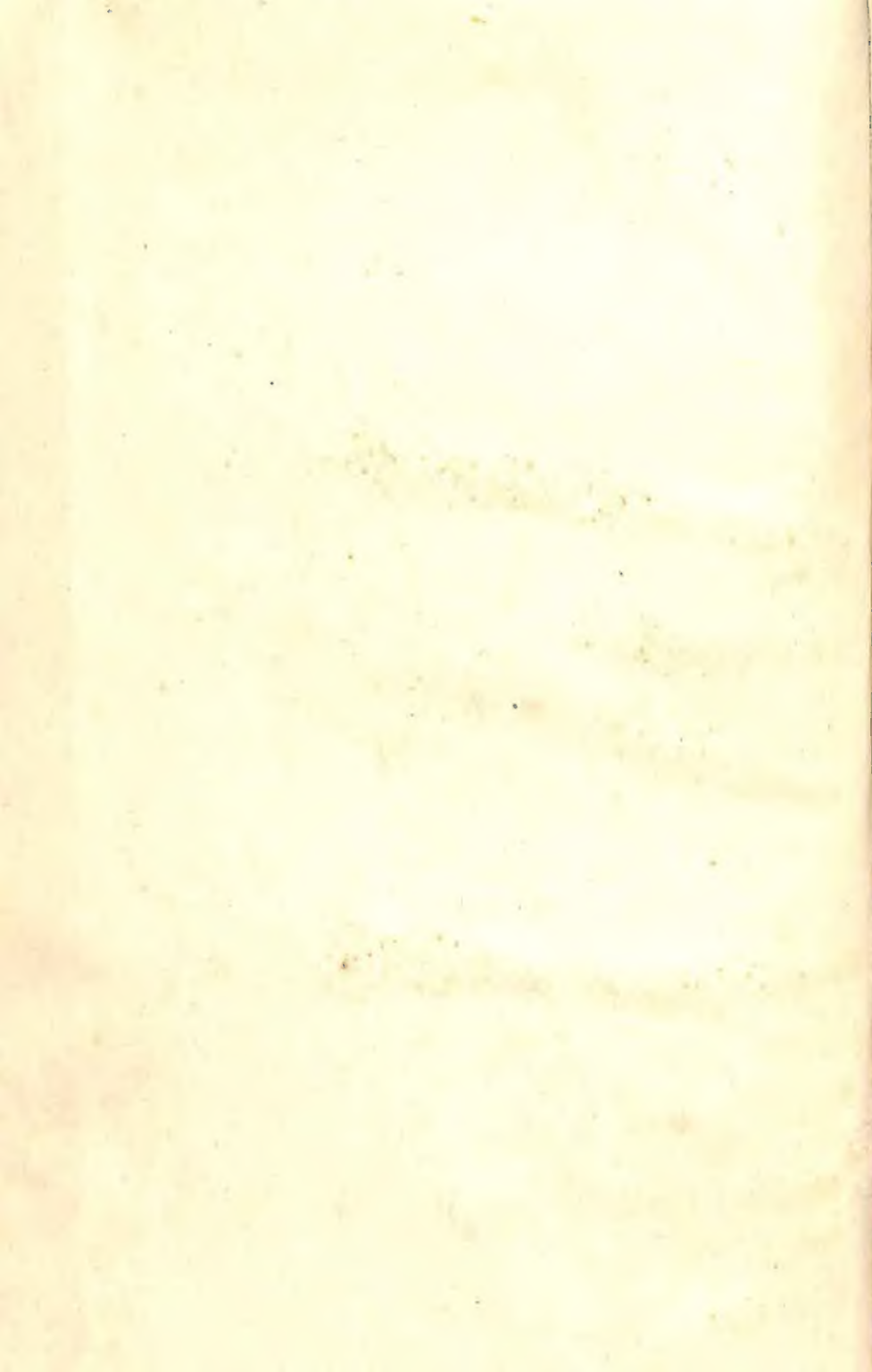


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**SCIENTIFIC METHOD
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**Scientific Method
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PREFACE TO THE FIRST EDITION

The importance of systematic and organised knowledge can hardly be exaggerated in social research. In order to acquire knowledge of social problems in a scientific manner, it is necessary to have some knowledge of research methods through which the scholar can see the things in their proper perspective. A research-oriented mind can appreciate and inculcate objectivity to a considerable extent. Research is necessary to understand the reality and to attain the truth. A dispassionate lover of truth must be acquainted with the methods in research to help himself to dig out the truth. This apart, the phenomenal growth of research in social sciences necessitates the understanding of their research methodologies and techniques.

We have made an attempt to critically expose and analyse the techniques applied in social science research. The book aims at acquainting the beginners with the basic research procedures. It is both an introductory and a reference book for the students of social sciences. The book, it is hoped, will provide the researchers with a ground work of knowledge broadly about the methodology of research, through its emphasis on every constituent step of the research process.

The book is an analytical study of different facets and contributions of scientific method to research methodology. Every aspect of scientific method is incorporated in the book to make it comprehensive, analytical and up-to-date. The book presents a synoptic view of the entire body of Scientific Method. In both depth and range, the book covers a very wide area. It is written with special reference to methods in social science research. The treatment of the book is exceptionally lucid and incisive; but extremely delicate and threadbare.

Research is a means to the advancement of knowledge and of science; but a fruitful research study appears to be almost impossible without the proper understanding of research methodology. An attempt has been made in this book to acquaint the readers with certain problems which are often encountered by the researchers. The book, of course, does not provide any royal road or any fixed principle for research, for there is no hard and fast rule for research. Every research area is a new world full of new problems requiring perhaps new thinking and understanding. Thus, in a way, research methodology remains more a matter of understanding, appreciation

and realisation than of formal teaching and learning process. However, the researchers must be aware of and acquainted with certain techniques and problems so that operational difficulty may be easily tackled. The book is written with a view to providing the researchers with such an insight.

Statistical method, needless to say, has an important bearing on social research. But it is a separate discipline by itself, and hence, we have not included the various formal statistical techniques in our book. The researchers can thoroughly acquaint themselves with the statistical method with reference to some standard works on the subject.

While preparing this book, I have incurred intellectual indebtedness to many for their help and cooperation. The book is an outgrowth of my notes which I prepared for my students of the post-graduate classes a couple of years back. We learn as we teach. I have tried to incorporate what I could learn in the process of teaching my students in different colleges and universities.

I am grateful to Dr Vikas Misra, Ex-Vice-Chancellor, Kurukshetra University, who has whetted my appetite for knowledge in the area of scientific methodology through his learned discourses. I should be thankful to Mrs Bulbul Ghosh for her valuable comments, constructive suggestions and painstaking secretarial assistance. My thanks are also due to Sneh Prabha, a former student of mine, for helping me to arrange the contents and, for checking a good bit of the manuscript.

B.N. Ghosh

PREFACE TO THE SECOND EDITION

I am very happy to note that the readers have received the book with much alacrity, as was expected. The First Edition of the book was exhausted within a few months of its publication. In the Second Edition, different types of errors including printing mistakes have been eliminated, and the factual information made up-to-date. Any suggestion towards the improvement of the book will be highly appreciated.

B.N. Ghosh

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Science and Knowledge

THE MEANING AND NATURE OF SCIENCE

Meaning

A science is a body of systematic knowledge. A science is a system of knowledge. A system consists of a number of things which are related together in a particular way so as to serve a particular purpose. The proper understanding and explanation of facts lead to the development of science. There is an inherent urge to know and understand facts, and this is done by relating the facts together. A meaningful relationship between facts is established through rational explanation. Explanation becomes the basic feature of sciences. The ideal of science is to achieve systematic inter-connection of facts

The finding out of inter-connection of facts is the first significant step towards the development of systematic knowledge which a science represents. The relating of facts is done in science by connecting them to laws. The search for laws is one of the important distinguishing features of every science. In fact, this aspect differentiates science from the ordinary knowledge. In science, laws are explained by constructing theories which relate the laws into a system.

But the formulation of laws or the construction of theories is not simply a matter of observation. It involves reflection, and reasoning. A science is also self corrective in nature. If new facts are discovered and new reasoning is developed, the old conclusions are revised and reformulated. With the help of developed laws, a science undertakes predictions as to the future course of certain events. The power of prediction constitutes one of the important functions of a science.

Broadly, there are two types of sciences : (i) formal or deductive (ii) empirical or inductive. In the first type, the system is developed through definitions, axioms and inference from which conclusions are developed from the deductive method of reasoning. Pure Mathematics is an example of formal science. But Physics is an example of an inductive science, because it is based on facts which are given by

experience. There is no choice of facts, and facts are developed primarily by the inductive process of reasoning. Empirical sciences are based on experience which means knowledge obtained by observation. The facts of material world studied by Physics, and the facts about human life that social sciences, like Economics, study are based on observation. In all empirical sciences, verification plays an important role in the search for the attainment of truth, which is the ultimate aim of all sciences.

Science as a Chain of Models

Sciences study inter-relations among facts. Knowledge entails explanation, and explanation is an essential feature of a science. Explanation is implicit in the universe of formal relations as well as in the universe of matters of fact. Explanation is the relationship between different parts or facts of the branch concerned. Sciences try to explain the things in terms of relationship.

Facts appear before us in totality. But at any point of time, we can conceive of a universe of fact i.e. a universe which is empirical in nature along with its relations. Thus, at any point of time the universe of facts appears as a double universe. The two universes (formal and empirical, or universe of facts and universe of relations) are autonomous and independent, but they are complementary to each other. If there is no relation between the two universes, the formal universe would be meaningless and the empirical universe would be dark. These two universes comprise formal science and empirical science respectively; and each science has different sub-universes.

The matters of fact in the various empirical sub-universes are not necessarily physical entities, but attributes of entities which could be included in so many sub-universes simultaneously. These common attributes have significant analytical similarities, and form a group of inter-related matters of fact. These common attributes constitute the subject-matter of an empirical science. Sciences can be distinguished according to their subject matters. As in the empirical universe there are two broad divisions, namely, physical and social, so correspondingly we have physical and social sciences. Likewise, sciences can be distinguished in terms of method. So far as logical reasoning is concerned, all empirical sciences are fundamentally the same. But since different degrees of ease or difficulty are experienced in the application of principles and processes of inference, on account of nature of subject-matters of sciences, differences in method become inevitable. Over and above the generally accepted principles and processes of inference, different sciences may have to evolve their own special techniques of analysis.

Explanation establishes relationship between facts meaningfully. For the purpose of finding out such relationship, we often have to go to the level of abstraction. At a high level of abstraction, the distinction between formal and empirical sciences gets blurred. At this

stage, the deductive structure of an empirical science becomes a mere elaboration of hypothesis.

These relationships between the facts which are used for systematic explanation are called Theories or Models. The objective of every model is the simplification of reality which is essentially complex and perplexing. A model seeks to simplify reality by isolating the remote and indirect variable factors through abstraction.

Every science can be conceived of as a separate chain of models. It is a chain of models because, being a unified and organic whole, the models in a science must be interlinked. In every science, so to say, there are several sets of models, and every set can be regarded as an envelope covering the models within it. The envelopes of different models are themselves linked together. Since sciences are parts of human knowledge as a whole, and since they are related to one another, they can be conceived of as inter-linked envelopes of models.

Order in Science

It is difficult to find out order among facts. However, different people have tried to do so. Bacon is said to have found out an order. Similarly, J.S. Mill has explained order among facts in his methods of experimental enquiry.

The purpose of science is to find the order among facts. Isolated facts do not constitute science. It is generally believed that science aims at finding out, exclusively, a causal order. Various types of order are regarded identical to causal order. A science is interested in finding out the following types of order :

(i) There is a type of order which is so familiar to us that we often forget it. We often give special names to certain things, e.g., air, water, soil etc. Such names are given to these things in order to distinguish them from other such things. The concept of "thing" is a vague concept; however, it denotes an elementary but fundamental type of order. Every "thing" denotes certain invariable association of properties, which is different from other associations of properties. However, this type of order is not causal order. Anyway, this type of order is fundamental to the search for physical order. The classification of things on the basis of our experience can never be complete.

(ii) A type of order which involves temporal span or direction is known as a causal order, e.g., "Iron rusts in moist air". Here, moist air is the cause because it produces rusting, which is the effect. A cause is an instance of invariable relation between two or more processes. A causal relation is asymmetrical and temporary in nature. However, the apparent invariability of causal relations is often regarded as specious. Iron does not always rust in moist air. It is not the moist air alone that is the cause of rusting; some other factors are necessary to produce this effect—i.e. rusting. Thus, in developed

sciences, a gradual transition takes place from approximate observed uniformities to a more complete analysis of invariant relations.

(iii) With the help of numerical equations, many uniformities can be expressed. For instance, Ohm's Law of Electricity states that the current is equal to the potential difference divided by resistance. However, this type of invariable relation does not speak anything about the sequence in time, and it is not regarded as an example of causal order. In effect, Ohm's law states that "The measurable elements observed stand to each other in the specified invariable relations"

(iv) There is another type of order among facts where all the elements between which there is an invariable relation, cannot be directly observed or experimented, e.g., the theory of gravitation, or atom. Such theories show that many numerical and qualitative laws can be regarded as the necessary consequences of the more abstract and inclusive order expressed in the theory.

Thus, we see that all these four types of order assert some kind of invariable relation between various types of elements. This invariability is very significant. The search for a cause may be understood as a search for an invariable order between various elements. The exact nature of this order will vary with the nature of the subject-matter and purpose of enquiry. The specific nature of the elements between which order is believed to be existing will also differ for various enquiries. In certain cases, we know the invariable order and some elements, and we may search for further elements. In certain cases, we may come to know the elements first, and then search for an invariable order among facts. In certain other cases, we may know the change, and may look for other changes which are unknown to us.

The type of elements or changes for which we search depends on the structure of the order which interests us. The type of order or the type of elements we search for, is decided by the nature of the problem that gives rise to the enquiry. The answer to one problem is not necessarily the answer to another problem.

Nature and Characteristics of Science

1. A Science is a system. It is a system of knowledge where so many facts are related together. It is a system of organised knowledge.
2. A science is empirical in nature. In a science, knowledge is obtained by observation. Verification plays an important role in science. Verification is based on the facts which we observe and experience.
3. A science is based on critical discrimination. It is objective and impartial.

4. A science deals with the general nature of things and events, and it consists of general explanations and principles.
5. A science is a body of reasoned knowledge. Laws are formulated in a science on the basis of reflection and reasoning.
6. A science is self-corrective in nature. Whenever new facts are found, the old conclusions are revised, if the new facts demand so. It is based on systematic doubt and search for new facts.
7. A science is objective in nature. A science does not depend on subject attitudes like feeling, temperament, bias, etc. A science takes facts as they are in an impartial manner. A science is neutral and free from any prejudice.
8. A science formulates laws. Facts are explained with reference to laws. Laws are explained by constructing theories which relate the laws to a coherent system.
9. Another feature of science is its function of prediction. On the basis of laws, a science can predict the happening of certain events.

Value Judgement and Science

Value judgement is regarded as not a part of scientific method. Where value judgements are involved, a science has no method to decide as to which fact is conclusively to be preferred. Thus, value judgement has no place in scientific method. A science is said to be value-free. It is neutral between ends. All ethical judgements and statements which perform recommendatory, persuasive and suggestive functions are value judgements. A science deals with ascertainable facts which are not concerned with value judgements and ethics. A science is objective, whereas a value judgement is subjective. Therefore, value judgement cannot form the subject-matter of a science. If a science is to progress towards objectivity, the influence of personal feeling or bias on experimental result must be minimised. There is no scientific method of testing the validity of certain values—only the consequences may, however, be scientifically known. Sciences can tell us how to achieve goals; it cannot tell as to what goals should be sought.

However, it is stated that a science is based on assumptions that are essentially value judgements.¹ Science itself has developed an ethic base on the assertion that knowledge is superior to ignorance. But these do not impair the objectivity of science; but they rather point out that science has its own metaphysics. Appraisal and selection of problems and motivation behind the selection of science as a career, are value-related aspects of science.² But it does not mean

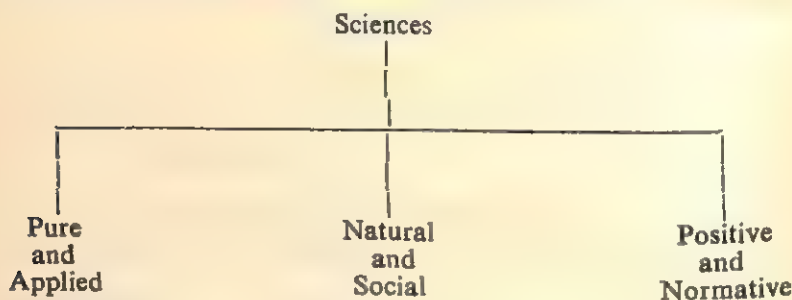
1. Goode and Hatt, *Methods in Social Research*, p. 28.

2. Loc. cit.

that the validity of science is determined by values. In the development of science, the possible sources of subjective bias must be carefully guarded against.

Classification of Sciences

Sciences are classified into the following categories :



(i) *Pure and Applied Sciences* : A pure science is concerned with the search for the truth about different types of events for the purpose of obtaining knowledge. It is not very much concerned with the direct use of such knowledge. It formulates laws and theories and develops a system for the purpose of understanding the subject-matter.

An applied science also gathers knowledge; and it tries to apply practically the obtained knowledge.

These two sciences are closely related—the former is theoretical and the latter is practical. Even, a particular science may have two branches—e.g., Pure Economics and Applied Economics; Pure Mathematics and Applied Mathematics.

(ii) *Natural and Social Sciences*: Natural sciences study natural phenomena. Natural sciences are classified into Physical sciences (Physics, Chemistry, etc.) and Biological sciences (Botany and Zoology). Physical sciences study the phenomena concerning non-living matters, whereas Biological sciences study the phenomena concerning living beings.

Social sciences study the phenomena concerning the life of human beings in society—their behaviour, institutions, etc. Social sciences have different branches, e.g. Economics (study of the economic activities of human beings), Political Science (study of the political activities of human beings—political organisation, processes, rights and duties etc.), Sociology (study of social behaviour, organisation and activities), Management (study of a group's business and economic activities) etc.

(iii) *Positive and Normative Sciences*: A Positive science studies facts as they are, i.e. no distortion of fact, or subjective bias

is made. It is concerned with the objective truth as given by the facts. Physics, Chemistry, Geology, Astronomy, Biology, etc., are all positive sciences. Positive sciences are descriptive and objective. The objective of positive sciences is to ascertain a fact as it is and to know the law that governs a phenomenon. The laws of these sciences represent facts that cannot be easily challenged, unless some new evidence or fact develops. The generalisations of these sciences are not influenced by social or individual values or norms.

A Normative science is based on norms or a standard. It sets up norms for the judgement of the phenomena. That is, it makes subjective evaluation or value judgement. It gives judgement as to what is good and what is bad. It studies things as they "should be"—i.e. with reference to a norm or standard. Normative sciences are Ethics, Aesthetics, etc. The norms or the standard in a normative science is based on the conceptions of truth, morality, beauty, goodness, etc. However, these conceptions differ from person to person, from time to time, and from society to society. Ethics aims at finding out the nature of goodness of conduct; Aesthetics lays down the standard regarding beauty. The approach of a normative science is evaluative.

Are Social Sciences Normative?

Social sciences are, to some extent, normative, because they are laying down the standard which ought to be attained for increasing human welfare. They are laying down the standard of goodness and badness. Marshall and Pigou have opined that economists have to examine everything from the point of human welfare. Without introducing value judgement, no meaningful proposition in economics can be made, says Samuelson. Economics is not only light-bearing but also fruit-bearing. But Robbins points that economics is neutral between ends and it is not a normative but a positive science. However, it is the function of social science, as Scitovsky remarks, to make value judgements and recommendations on the distribution of welfare.

SCIENCE, ART AND PHILOSOPHY

Science and Art

A science is a systematic body of knowledge. One can study a subject with the help of scientific knowledge regarding the subject-matter. Art is the practical application of the knowledge. A science teaches to know; an art teaches to do. Knowledge necessarily does imply its practical application. A man may have knowledge about electricity, but he may not repair or be able to repair electrical equipments. However, an electrician may very well repair electrical equipments, but he may not be a scholar of electricity—he may not have sufficient theoretical knowledge. An artist depends on practical training and skill, whereas a scientist depends on inference, observation

and experiment. Art is creative, but a science is analytical. Art is qualitative, but a science is quantitative. Art is subjective, but a science is objective. The end-result of the work of an artist is a particular piece of creation; whereas the end-result of the efforts of a scientist is a generalised explanation or law. However, science and art are complementary—science improves art, as art improves science.

Science and Philosophy

A science is based on empirically verifiable data, but Philosophy is not so. A science studies the material world, but Philosophy studies the material and non-material aspect of the Universe—the real nature of a total phenomenon. A science is based on observation and experiment, but Philosophy is based on speculation and reflection. Philosophy uses critical faculties. Philosophy studies the ultimate nature of existence in general; whereas a science studies a particular aspect or a particular subject-matter. In Philosophy, experience is not empirical, but in science, it is empirical. Philosophy analyses, examines and clarifies the concepts which are assumed by a science. A science is quantitative, but Philosophy is qualitative. A science is not concerned with the purpose of the phenomena, but Philosophy is concerned with the purpose. Philosophy integrates the findings of sciences, and provides the real explanations and tools with which a scientist can investigate into the mysteries of nature. However, science and Philosophy are closely related.

HUMAN KNOWLEDGE

Meaning and Nature of Knowledge

A full discussion of the theory of knowledge is the province of Epistemology. We are discussing here in a most general and limited way the meaning and nature of knowledge.

Knowledge has something to do with knowing. Knowing may be through acquaintance or through the description of the characteristics of certain things. The things with which we can be acquainted are the things of which we are directly aware. Direct awareness may come through perception and sensation. Most of our knowledge of things is by description. Had our knowledge been confined only to acquaintance, we could know really very little. Knowledge by description is strictly personal and individual, and is also probabilistic.

Knowing obviously has an external reference, which may be called a fact. A fact is anything that exists or can be conceived of. A fact is neither true nor false. It is what we know about facts which can be either true or false.

What we claim to know is belief or judgement. But every belief cannot, however, be equated with knowledge, because some of our beliefs, even the true ones, may turn out to be false on verification. Knowledge, therefore, is a matter of degree. However, knowledge need not always be private or individual. Private knowledge may be transformed into public knowledge by the application of certain scientific and common sense procedures. True beliefs can be there without direct perception with reference to facts.

Human knowledge takes the form of beliefs or judgement about a particular phenomenon. Some beliefs may be supported by evidence and some are not. The evidence may be based on our perceptions and experiences. The beliefs which are supported by evidence are called justified beliefs. Only justified beliefs are knowledge. Ordinary belief is not knowledge. Justified beliefs consist of two types of judgements.

- (1) Direct or Intuitive judgements
- (2) Derived Judgements.

The direct judgements are based on our sense perceptions. Derived judgements are formed out of the existing body of knowledge. This type of knowledge is gathered from the process which, in logic, is known as inference. In this way, from a given judgement, more judgements can be formed. A single direct judgement may lead to a large number of inferences or derived judgements. A large part of our knowledge is based on derived judgements. Knowledge may be collected from different sources, e.g., experience, human beings, books, Nature, etc.

Knowledge includes what we know about matters of fact as well as the principles and processes of inference. Knowledge has three elements: (i) there is a system of ideas, (ii) the ideas correspond to things actually existing, and (iii) there is belief in such correspondence. Knowledge covers an area where explanation is either not explicitly relevant or just not possible.

However, self-evidence is an essential condition for knowledge, but it is not a sufficient condition, because self-evidence is a matter of degree. Knowledge depends more on ability rather than on possession. The origin of knowledge is empiricism and experience.

Fundamentally knowledge is indivisible; but limited powers of human assimilation and apprehension require that knowledge should be divided and separated. Division of labour and specialisation are causes as well as consequences of the growth of knowledge. Specialisation refines the technique of analysis of knowledge, and discovers new facts and their mutual relationship, and thereby, contributes a good deal to the growth of knowledge. The most important factor in the growth of knowledge is the inherent human curiosity itself.

However, according to some, knowledge is a vague concept for some reasons: (i) meaning of a word is more or less vague except in logic and mathematics, (ii) knowledge is uncertain, and there is no way of deciding as to how much uncertainty makes a belief unworthy to be called knowledge.

Knowing entails explanation. When we come to this stage we have science. When knowledge is applied from a particular world to the common world, we get the features of scientific theory which unfolds the whole universe of knowledge.

Knowledge and Science

A science is a body of systematic knowledge. All sciences are knowledge, but all knowledge is not science. The following are the differences between knowledge and science:

(i) A science deals with particular knowledge, whereas ordinary men are interested in the whole body of knowledge—to know something about everything.

(ii) Scientific knowledge is unified, organised and systematic, while ordinary knowledge is a jumble of isolated and disconnected facts.

(iii) A science applies special means and methods to render knowledge true and exact, but ordinary knowledge rests on observations which are not methodical.

But scientific knowledge and ordinary knowledge are not different in kind, but only in degree. Scientific knowledge is more specialised, exact and organised than ordinary knowledge.

We have already shown that knowledge requires explanation, and there science comes in. Knowledge and science are not necessarily synonymous. Science implies knowledge, but the converse is not true. Knowledge covers areas where explanation is either not explicitly relevant or just not possible or not contemplated. Explanation is only implicit in the universe of formal relations as well as in the universe of matters of fact. Therefore, logic and pure mathematics are as much science as physical and social sciences. Explanation essentially is the relationship between different parts or facts of the branch concerned.

Even isolated beliefs can fall under knowledge. But only those beliefs which have some sort of affinity or interconnection can fall in a particular universe of science. Unlike in knowledge, in science, explanation is always found relevant, necessary and explicit.

In so far as the various sciences are not unrelated to one another wholly, they form parts of human knowledge as a whole, and all

sciences can be conceived of as inter-linked envelopes of models. It is this interlink which distinguishes science from ordinary knowledge. A systematic body of knowledge only can be called a science.

Appendix

STOCKS AND FLOWS OF KNOWLEDGE

In a recent article in *Kyklos*, F. Machlup¹ has tried to build up a conceptual frame-work for analysing the stock and flow of knowledge. He aptly remarks that any attempt to quantify knowledge has had many limitations: Obviously his is a conceptual exercise in which a few comments can perhaps be accommodated to clarify and extend his conceptualisation.

A proper definition of knowledge is essential before one attempts to measure its stock and flow, for knowledge may have different components or may be of different types, e.g., subjective and objective, material and non-material, productive and unproductive, systematic and unsystematic, applied and theoretical, or it may be any information, fact, belief or judgement. In fact, differences in conceptualisation will lead to different estimates of stocks and flows.

Machlup has mainly based his discussion on Price's theory for estimating the stock of recorded knowledge, on Gore's and scientometricians' studies for discussing the role of books and on phenomenological theory for estimating the knowledge of human mind. All these studies have their own limitations and they conceal more than what they reveal. His attempt to "estimating the stock of recorded knowledge" and "estimating the flow of knowledge" is abortive, for these do not give any precise estimates. Strictly speaking, the stock-flow analysis should be in terms of some measurable units. Knowledge being an intensive quality, having no meaningful unit, cannot be estimated in stock-flow terms. Of course, one can always vaguely describe any accumulation as the stock and its distribution as the flow upto a reasonable limit. What Machlup calls 'flow' is perhaps the transmission of knowledge.

Among recorded knowledge, he has included only published material. What about the unpublished or non-marketed papers? The scientometricians observe that growth of knowledge is more meaningfully estimated by the number of articles in scientific journals rather than by the number of books (p. 401). This statement does not appear to be correct for the following reasons: (i) there may be original research books in any discipline, and (ii) even literary and other journals substantially advance knowledge. There may be possibility of duplication and the growth of same knowledge (findings) by

1. Fritz Machlup, "Stocks and Flows of Knowledge" *Kyklos*, Vol. 32 (1979) 1/2. pp. 400-411.

different methodologies. The last point is particularly true with respect to the so-called scientific journals in low-developed countries (LDCs).

The categorisation of scientific journals is sometimes arbitrarily made. Many existing journals in the world are scholarly journals without being scientific or technological. Many renowned scholars/scientists have been writing in very ordinary journals. According to Machlup, the question regarding the equivalence or otherwise between short and long articles become irrelevant if their ratio remains more or less constant over time (p. 401). These ratios, needless to say, do not reflect anything about the stock of recorded knowledge. So far as the growth of knowledge is concerned, a paper or volume is not to be judged by the quantity of materials it contains but by its quality, originality and the spirit of innovation it generates. From the point of view of growth of knowledge, an entire volume may be useless, but a single issue or paper may be very valuable. It is worthwhile to distinguish between ordinary articles and research papers, the former very often represents assimilation from the existing recorded knowledge and does not contribute anything to the growth of new stock of knowledge. In view of all these, it is difficult to agree with Machlup's observation that the simple estimate of a stock of knowledge would be in terms of volume (p. 401). We may get a better estimate of the growth of the stock of knowledge by eliminating reproduced papers, ordinary assimilated articles and duplicate records from the total volume of publication.

The calculation of the exact number of journals published in the universe is a tedious physical job. Price's calculation of the number of journals published in a period of time on which the author relies is not very helpful, once we adhere to the notion of the growth of stock of knowledge over time. 5 per cent annual rate of growth of population of journals is arbitrary. What is more crucial is the net rate of growth of journals (birth rate minus mortality). In his attempt to estimate the stock of growth of knowledge, he considers only the journals of natural sciences, mathematics and technology (p. 403). One wonders why he is constrained to exclude arts subjects and social sciences.

He opines that books matter in humanities and social sciences. Why should one not take into consideration research journals in these fields? Do the books not matter in natural sciences, technology and mathematics? Machlup reports that in the USA, the combined library collection of books in 1975 contained nearly 9 million titles (p. 404). Apparently, library books contain reference books, textbooks and pure research books. Many books contain the same theories and knowledge; the explanatory style, languages or wordings may, of course, be different. Unless such duplicate works are eliminated, mere counting of number of titles would be a futile exercise.

As Machlup observes, the knowledge of the living people is the

relevant social stock of knowledge (p. 405). On the basis of their differences in skill, education and training, different people will have different stock of knowledge. As such, recorded knowledge remaining fixed, there would be differences in knowledgeability. It should, however, be borne in mind that the stock of knowledge is a function of many factors, e.g., capacity to know, willingness to know and the facilities to know. These factors will have their effects on the stock of human knowledge. To appreciate the stock of knowledge in human mind, it is necessary to classify human beings and observe their essential differences, as in the following chart which is self-explanatory.

Attributes/Manpower Category	Illiterate	Fairly Literate	Highly Qualified
1. Basic Low-level Common Knowledge	Equal	Equal	Equal
2. Absorptive Capacity or Power of Assimilation	Very Low	Low	High
3. Actual or Potential Contribution to Knowledge	Nil	Low	High
4. Possibility of Extending Scope of Knowledge	Very Limited	Limited	Large

Machlup has not considered it necessary to distinguish between social stock of knowledge (SK) and private stock of knowledge (PK) on the basis of any criterion (though it is necessary) nor has he made any distinction between subjective (s) and objective (o) knowledge. In a very general but meaningful sense, social stock of knowledge is more organised and objective (o) and is in the nature of a public good, whereas private stock of knowledge is more subjective (s) and is in the nature of a private good. Once one is permitted to make this distinction, the following four possible situations emerge :

$$\begin{array}{llll}
 SK_s & > & PK_s & \dots\dots\dots (i) \\
 SK_o & > & PK_o & \dots\dots\dots (ii) \\
 (SK_s + SK_o) & > & (PK_s + PK_o) & \dots\dots\dots (iii) \\
 (SK_s + SK_o) & = & (PK_s + PK_o) & \dots\dots\dots (iv)
 \end{array}$$

The above four cases can be considered to be true in different situations. It is too much to accept Schutz/Luckmann's view (p. 406) that social stock may be less than any particular subjective knowledge. The biographical uniqueness of experience and other unusual elements of a particular person may also be present in a greater degree in the social stock of knowledge in terms of subjects, theories

and informations. However, it has to be noted that scientific knowledge is not the sum of all knowledge, for some knowledge remains always unorganised. Subjective knowledge is basically incomplete and imperfect. In order to make it objective, it has to be properly processed and systematised. However, the social stock of subjective knowledge, provided the latter possesses some hitherto unknown knowledge over and above knowing the entire social stock of knowledge (both subjective and objective), is a very heroic assumption to make. Social knowledge should be used in net sense, whereas private knowledge can more appropriately be the gross one.

A society may be looked upon as a different type of individual. The introduction of a new knowledge will at once increase the social stock of knowledge, but it may not increase the private stock as a whole, albeit at least one person who has made the innovation will have increased his stock. All private stock of knowledge will increase the social stock, but the *vice versa* may not be obviously true, for there are various constraints to the flow of knowledge. Social knowledge cannot be considered to be equal to the sum total of private knowledge: their component ratios are different. Thus, our case (iv) earlier may not be strictly valid. The theory of cybernetics has increased SK, but even if this knowledge is imparted to several million people, the social stock will remain the same; what will increase is the PK. Machlup has posed the following two questions regarding the spread of knowledge: (a) more people may be imparted the same knowledge, (b) same people may be imparted more knowledge. Both will raise private stock of knowledge and both are necessary, but a choice has to be made between the first which can be called extensive or basic education, and the second which may be called intensive or specialised education. While the first type is more suitable for a low developed illiterate society, the second type is essential for a developed and educated society.

According to Machlup, the problem of quantification of the flow of knowledge can be avoided by assuming that all newly recorded knowledge is read and absorbed at least by one person (p. 408). Firstly, this assumption is obviously unrealistic, and even if it is presumed to be valid, how will that avoid the quantification problem *per se*? The scientometricians' attempt to measure the flow of recorded knowledge in terms of physical units is not at all correct. What is the unit and how can one find a successful criterion for calling a bit of knowledge as one unit? The whole state of affairs is a horrible mess of misconception. The author assures that in some areas of knowledge transmission, it is possible to count physical units. Instead of telling us how to find out the physical units, he advises to note the differences in volumes, library materials, numbers and sizes and so on relating to knowledge media. But this does not solve the problem of finding out the appropriate unit. What he precisely speaks of (p. 409, para first) is the speed of work, and the efficiency of different

communication systems, and not about the measurement of knowledge as such.

Machlup believes that expenditure incurred or revenues collected, expressed in monetary units on education, can be regarded as a measure of the flow of knowledge (p.409). We may purchase more books, equipments or gadgets, but do these by themselves guarantee the increased flow of knowledge? However, the growth of social knowledge can partly be known by the degree of advancement of technology or the improved vintage, which can be gauged by comparing the old and the new cost-benefit estimates. For a society, cost incurred on old knowledge will not increase the stock, but only the production of new knowledge will enlarge the stock. Expenditure even on research may not always lead to the dissemination of knowledge. Although it provides a new insight into the existing stock of knowledge, it may lead to duplication of results already known to the society. Returns are proportionate to the scale, but the cost of knowledge may be very often scale-free. Thus, cost cannot be meaningfully related either to stock or to flow of knowledge.

In Machlup's conceptualisation, the flow of knowledge may be of five categories, accumulation, replacement, current input, consumption or waste or any combination of these factors. One can also conceptually consider knowledge as a future (potential) input helping production later on. What the author has overlooked is the fact that such a classification is not only relevant to the flow but to the stock of knowledge as well. Accumulation, to him, is the flow which makes a net addition to the social stock of knowledge. Why can it not be considered to be a net addition to the private stock of knowledge? Ordinarily, a flow of knowledge, more often than not, does not lead to social accumulation but to private accumulation. This point has been missed by the author. Machlup speaks of the replacement of that part of the stock of knowledge which has been forgotten, wiped out by death, or has become obsolete. We must remember that in the case of recorded or already transmitted knowledge, the question of replacement becomes less important. The crucial question is: how far can knowledge be considered to be obsolete or waste? None can be sure. What is the mechanism to determine whether a particular piece of knowledge is forgotten, obsolete or a waste? What may appear to be obsolete or a waste today, may appear to be very new and useful tomorrow under a different value system, time horizon and social structure. One of the ideal examples, is the recent revival of the Yoga system and natural therapy in most of the Eastern countries today. Again, what is useful in one type of society may be useless or even harmful in another system. Many will believe that borrowed technology or western growth models cannot be profitably employed in LDCs. If wastage is involved everywhere, it should not be taken as an exclusive category as the author makes it to be.

Machlup has attributed waste to both flow and stock. The

statement : "virtually every flow of knowledge may have an admixture of waste, some efforts of producing knowledge proving either abortive or superfluous" is a *non-sequitur*. He has mixed up in connection with 'waste', flow and stock which form entirely two different categories of concepts. To calculate wastage through the cost benefit approach which the author has in mind (p. 411) one has to employ monetary terms. But knowledge being what it is, no monetary calculation of waste appears to be feasible. We can, at the most, say which technique is better without, perhaps, quantifying the wastage involved. The cost remaining the same, one technique may prove monetarily gainful; and the gain or result remaining constant, a high-cost technique does involve some comparative material loss. But it is preposterous to call it wastage of the flow of knowledge. In fact, every flow of knowledge is associated with an opportunity cost. Knowledge can be regarded as waste or unproductive if that opportunity cost cannot be covered. But how does one know at the moment that the opportunity cost cannot be covered even in the long run ? As the proverb goes : knowledge is power, and knowledge is its own reward. It always equips man with the ability to differentiate between good and bad, pure and impure, right and wrong. Considered this way, knowledge is never wasted. As a matter of fact, knowledge even faces diminishing marginal utility in terms of the material fruit it generates; but it is far from useless. Knowledge is not merely a fruit of contemplation, but an instrument of change as well.

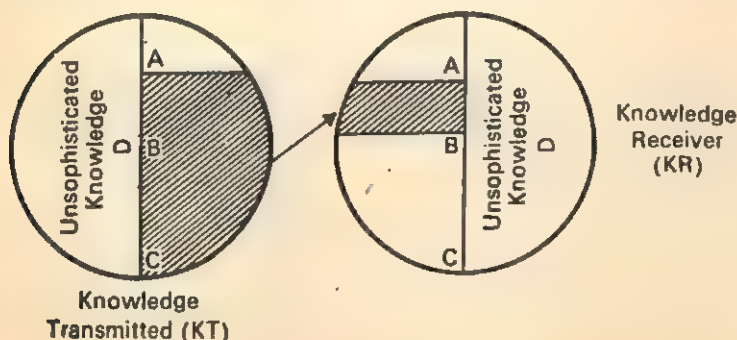
One indeed has to be very cautious to consider a particular flow of knowledge as "current input". How can one ensure that it will help only current production and not the future one ? In the area of production, current and old technologies are in symbiotic relation. In reality, it is very hard to specify an input which will be currently used and not in the future. Of course, if its life-span is shorter, it can be reproduced with the same stock of knowledge. However, if the rate of technical change is very high, the rate of obsolescence also goes up, and less relevant becomes the current flow or even the stock. In computing the stock of knowledge as a current input, a steady rate of technical change can be constructed as a discount factor for past experience. The discount may work forward to reduce the current knowledge for future use. Investment in knowledge for future use may be uncertain, and unless the technology of learning is specified, any generalisation in this context is unwarranted.

The flow of knowledge can be, Machlup maintains, "consumption" if it helps current enjoyment (p. 410). Why does he exclude future enjoyment ? The same flow of knowledge may be a perennial source of enjoyment both at present and in future. The conceptual problem that arises are the following : (i) same flow may be a consumption good to one but may not be so for others (ii) same flow may be a consumption good to one at a particular moment of

time, but may not be so at another time. It is indeed very difficult to find out the analytical basis of the entire classificatory scheme which Machlup has made.

A word about the input-output and stock-flow aspects of knowledge. The same knowledge may be either input or output, or stock or flow, depending on the time, use, circumstances and the purpose. When some knowledge is discovered and is immediately transmitted, it can be both a stock and a flow. In the case of contradictory theories or empirical findings, it becomes a formidable task to tell precisely about the stock position. Machlup's net stock of knowledge (accumulation) is the gross stock minus replacement. But what is the mechanism to ensure that a particular flow is gross or net? When a research result is published, it becomes a recorded stock; but in the process of publication, it becomes a flow. A stock is already a flow and, vice versa. Thus, the distinction between the stock and flow of knowledge cannot be specified in clear-cut, apple-pie order.

Indeed, there is a big chasm between stock and the flow of knowledge. According to Machlup, the efforts at disseminating knowledge may be either due to the fault of the transmitter or of the receiver (p. 411). In fact, it may be due to the fault of both, or may not be anybody's fault. There are various constraints in the transfer of knowledge, some of which may be due to the peculiar social system. There may be socio-cultural inhibitions to transfer knowledge. The qualitative or conceptual knowledge may be described only in terms of the concepts that the receiver is already familiar with. Without taking into account the technique used, the real measurement of the effective flow of knowledge is impossible. The different possible levels of flow of knowledge between the transmitter and the receiver can be explained by the following diagram.



In Fig.A, the individual universe of knowledge is divided into two parts—unsophisticated (D) and sophisticated (A,B,C). A is

more sophisticated than B, and B is more sophisticated than C. Area A may be the unattainable absolute area of knowledge. We can conceive of the following three situations between K_t and K_r .

$$K_t > K_r \dots\dots\dots(1)$$

(As in the diagram)

$$K_t = K_r \dots\dots\dots(2)$$

$$K_t < K_r \dots\dots\dots(3)$$

Of these three situations, the third situation is conceptually impossible. Second situation may be called the optimum level of flow. The optimum level is not, however, a permanent and stable level; it may change into non-optimum ($K_t > K_r$), or the non-optimum situation may gradually be one of optimum. There can be no flow of knowledge which is higher than the highest level of sophistication achieved by the transmitter and the receiver. Any amount of pretence does not lead to any effective flow of knowledge, and sometimes it is difficult to know what we do not understand. In such a situation, there is no question of flow of knowledge. Language barrier is another factor inhibiting the effective flow of knowledge. Moreover, the knowledge of super-expert cannot very often be effectively transmitted to a layman. In fact, much is leaked out of the stream of knowledge in the process of its flow. Thus, flow cannot be made amenable to precise measurement. No analysis of stock and flow of knowledge can be made objectively rigorous especially when the stock and flow cannot be quantified. Even after accepting this truth, Machlup explicitly ventures to estimate the stock and flow of knowledge.

Methods in Science: Nature and Type

Nature of Science Determines Methodology (Role of Method)

Sciences, as a whole, lay greater emphasis on method than on result. A method is the way of approaching the problem. In order to find out the truth involved in a problem certain steps must be taken in certain order, and the ordered steps are called a method. If a science follows a wrong method, the systematic knowledge or the truth cannot be ultimately found out. Thus, the use of a correct methodology in science is very essential, because, unless the right methodology is followed, thoughts cannot be arranged in correct order. As a result, the exact truth can neither be discovered nor be exposed. Methodology stands for "the correct arrangement of thoughts either for the discovery or for the exposition of truth." A correct methodology is required for arriving at a correct or an exact knowledge which a science wants to establish. The consistency of thought cannot be attained by means of inconsistent set of reasonings or method. Whether a science is inductive or deductive, a correct methodology is always necessary.

In every science, the methodology, technique or device is relative to the problem. The type of steps to be applied will depend on the end that is sought to be achieved. Methods and techniques are not ends in themselves; but they are necessary to comprehend and interpret problems. The operative value of a method is related not only to the problem which is being analysed, but also to the alternative tools that may become useful in course of the analysis. Every method has its utility in the proper situation, and no methodology is by itself superior to another. Where one method is applied to find out the result, others can be used to verify the conclusions obtained. Prof. Northrop observes that there are as many different scientific methods as there are different kinds of problems. He opines that different stages of enquiry have different scientific methods, and that a method

which is scientific at one stage may not be scientific at another stage¹ Scientific method, like time and space, is relative to the stage of enquiry and the type of problem. In fact there are several types of rational methods and several types of sciences.² The appropriate method to be applied in a science is determined by the nature of the science. A method in science is highly elastic and adjusts itself to new problems as they arise.³ Different types of sciences study different problems and aim at discovering different types of laws

The method which is to be adopted in a scientific enquiry, therefore, is partly determined by the subject-matter of study and partly by the end or purpose of study i.e. the objective. The deductive sciences start from universal or general propositions and arrive at a particular or specific proposition. Inductive sciences start from particular and specific cases and arrive at general or universal propositions or laws. The analytical or experimental method is generally applied to a science which deals with concrete facts and instances; but as this science becomes more and more progressive, it makes use of deductive or synthetic method. For instance, to start with, physics was an experimental science using inductive methodology, but through evolution at various stages, physics has now become more and more deductive in nature, because it is amenable to exact quantitative measurement. Pure physics can, therefore, be regarded as quite akin to a deductive science like mathematics. The scope or the possibility of quantitative measurement in a science becomes one of the most decisive factors for determining its methodology. When an empirical or experimental science becomes amenable to exact quantitative measurement, it no longer remains empirical, but becomes mainly a deductive science. For instance, mathematics, pure physics, astronomy, etc. are deductive or synthetic sciences, whereas geology, chemistry, etc. remain inductive, experimental or analytic.

It is, therefore, clear that since the nature and objective of sciences differ, the methodologies have got to be different. Sciences like physics and chemistry depend upon controlled experiments, and sciences like astronomy depend on observation and calculation. Since human behaviour cannot be subjected to controlled experiment and observation, the social sciences usually follow a sort of inductive method where quantitative measurement cannot be applied with precision. In social sciences, therefore, trial and error, sampling and statistical methods are sought to be applied with as much accuracy as is possible. Thus, depending on the nature of the material or the problem under the consideration of a scientific study, the proper methodology has to be framed. In social sciences, in general, the research becomes either problem-oriented or method-oriented. But in every case, it is almost a general truth that the nature of science

1. F.S.G. Northrop, *The Logic of the Sciences and Humanities*, p. 30.
2. See, Litt and Caldin's *View in Science and Freedom*, 1955, pp 141-150.
3. Marganan, *Science and Freedom* (Proceedings), p. 148.

determines its methodology. This statement may be substantiated by discussing the nature of some of the sciences and their methodologies.

Some Sciences and their Methodologies

The objective of physical sciences is to unfold the mysteries of the inorganic world. They deal with and try to understand the organic world. Physical sciences are classified into the mechanical and the chemical. Physical sciences use physical methods in which deduction precedes induction. According to this method, deductions are first made from certain suppositions and then empirical verification is made. Thus, these sciences are analytic mainly, but they also take the help of synthesis.

The natural sciences progress by studying the process of evolution of living beings. The principle of natural selection and the principle of heredity have not been accepted without controversy. In natural sciences mere analytical methodology is not enough. They require more threadbare analysis and thorough study of facts. The explanation of the process of evolution of living beings, requires the help of mental construction and reconstruction. Natural sciences, e.g. biology, are still in their infancy, and have to go a long way before they can attain perfection.

Mathematics is purely a deductive science. It is not concerned with the facts of Nature and their relationship. Mathematics is based on axioms, definitions and proof. In mathematics, conclusions can be arrived at from self-evident propositions or principles. Mathematics, which is a deductive system, is concerned with working out the implications of propositions. Thus, in mathematics, the methodology is synthetic.

The historical sciences study the thoughts, actions and reactions of human beings. History cannot make use of observation or experiment. History requires the reconstruction of historical events, and in this mental construction, objective reference becomes essential. In history, classification, weighing of testimony, examination, explanation and formation of plausible hypothesis have to be done. The hypothesis can sometimes be verified by witnesses, other evidence and record. But in the act of mental reconstruction, good bits of subjective factors creep in. History takes the help of both deduction and induction. In historical method, induction precedes deduction. In history, empirical generalisations are first made, and then an attempt is made to derive them from other laws. The analytic method is used in history, since something is tried to be discovered; and since a great deal of exposition is required to synthesise the results, history has also to make use of synthetic method.

Social sciences, to a great extent, are historical. In social sciences like economics, political science, etc., experiment and observation

cannot be completely carried out. However, the social sciences are still following inductive method, such as, the building up of hypothesis and limited observation and experiment. In social sciences, particularly in economics, analytical studies are considered to be more important for empirical research. Empiricism becomes meaningless unless it is guided by some principle, theory or analysis. For analytical work empirical study is important for many reasons. The empirical generalisations can examine the validity or otherwise of both the assumptions and implications of an analytical work. The empirical generalisation can become the basis for analytical works.

In biology and social sciences, comparative method is generally applied. This method is useful for studying continuity and development. This method is also applied in social anthropology. This method suggests an explanatory hypothesis which can be developed by means of logical deductions. In comparative method, the irrelevant conditions are eliminated. This method is used to show that social institutions, like biological species, continuously evolve and pass through different stages. The stages represent temporal sequence. This method works through the study of comparative anatomy. Thus, it is clear that different sciences try to evolve methodologies which are relevant to their subject-matter and nature.

Analytic and Synthetic Methods

Analysis means the breaking up of a thing into its constituent elements. What is analysed is complex as compared to the elements which are simple. Analysis has to be made in order to know the cause or the effect of a complex phenomenon. Analysis can determine which elements are relevant and which are irrelevant. Analysis is the process of breaking a whole into its elements. The analytic method is called the method of discovery. The analysis may be either physical or mental. When a physical phenomenon is analysed into its different elements, the analysis is known as physical analysis. But when the particular aspect of a human being is analysed into its constituent factors, the analysis is called the mental analysis. In physical analysis, the factors are physically separated. But in mental analysis, the factors are only mentally analysed and separated. Analysis is only a method used to arrive at the truth of a phenomenon. But since it is a method, it is not an end in itself. Scientific analysis does not identify an object with the elements that constitute the object.

A synthesis is sometimes regarded as the reverse of analysis. A Synthetic method is called the method of exposition. Synthesis is the process of combination of parts into a whole. A system in a science implies the relating together of things in certain order. Since synthesis means the relating together of things, it can be considered as the fundamental aspect of a science. From the point of view of logic, synthesis starts from the simplest thoughts or notions, which are

ultimately united and related together. Geometry provides the best example of logical synthesis. When we say that the three angles of a triangle are equal to two right-angles, we are, in fact, making a logical synthesis. However, in geometry we very often use analysis also when we try to separate and identify the different properties of a figure. In natural sciences, a distinction between analytic and synthetic methods can be found out. A natural phenomenon can be considered with respect to its constituent elements, and, at the same time, different elements and their properties can be related together to fully explain a natural phenomenon. In induction, one is making use of analysis but in deduction, one is making use of reasoning which is synthetic in nature.

New truths may possibly be discovered also by synthesis and the old truths may be explained by analysis. The same science sometimes may be explained by analytic method and sometimes by the synthetic method. For instance, Prof. Herschel explains astronomy partially through analytic method; but Prof. Norman Lockyer explains astronomy through synthetic method. However, for a fuller understanding of things and for the progress of scientific knowledge, a combination of synthetic and analytic methods is urgently required. Both are equally fundamental to scientific knowledge and to the discovery of order in Nature which is the foundation of every science. Some phenomena are essentially complex. They are understood by means of simplification through the analysis of their component elements. Analysis is helpful for making meaningful comparisons. After the analysis is made, the relevant facts are separated out and related together in order to find out a general law.

Both analysis and synthesis are explanatory methods. They are helpful for our understanding of things and their relations. Through the help of synthesis, one can study the properties of the compound from the properties of constituent elements. Synthetic thinking is made possible by analytic thinking. The two are interdependent. In every science, they are used jointly, although in some sciences synthesis is more important than analysis, and in some other, analysis is more important than synthesis. The formulation of a law works in the direction of evolving a synthesis that makes use of analysis. The formulation of the concept of a class is considerably helped by synthesis on the basis of analysis.

At the initial stage of a science, analysis plays a more important role than synthesis. And as the science becomes more and more progressive, synthesis plays a more and more important role. But in every science both the methods are used simultaneously. The objective of analysis is to test hypothesis. Analytic and synthetic methods jointly work to arrive at the truth in a more convincing manner. The nature of the science determines the appropriateness of the synthetic or analytic method. When the subject-matter is highly abstract and the relations are formal, synthesis plays a more important role than analysis. But when the subject matter is less abstract and does

not admit of exact quantitative measurement, and the relations are informal, analysis plays a more important role than synthesis. Thus, in pure mathematics, the method is purely synthetic; and in chemistry, biology etc., the method is analytic. But even in pure mathematics, analysis is used in the explanation of the conditions of the theorems. Similarly, in psychology and biology, synthetic method cannot be given up. In order to reveal the complete picture of different forms of life in the organic world and the mental functions as the necessary correlatives of the nature of consciousness, the synthetic method is of much help.

A science aims at not only arriving at the truth but also at expounding the truth. A synthetic method is necessarily expository because it puts together the elements of a phenomenon in a systematic manner. In synthesis, exposition is possible because the entire elements are completely known and, as such, they can easily be arranged in an orderly way. The discovery of truth, however, is made possible by the method of analysis.

The inspiration of the scientist is one of the determinants of the part played by analysis and synthesis in scientific investigations. Some people have thoroughly searching minds and skill to find out the correct type of relations between things as compared to others who are devoid of such powers. In natural science, Darwin was such a genius. Similarly, J.C. Maxwell was efficient enough to predict a synthesis between the science of optics and the science of electrodynamics. But, for these outstanding people, analysis also became necessary. Newton was a scientist who primarily made use of the analytic method and who, due to his deep insight, was also able to unfold the involved synthesis. Thus, synthesis and analysis are the two legs on which the entire body of systematic knowledge of a science stands.

Methods of Social Science

Various methods, e.g., historical method, comparative method, descriptive method, scientific method, survey and field research method, institutional method, conceptual method, etc. have been applied to social science research. The first four methods are very interesting, and here we shall confine our discussions only to these methods.

HISTORICAL METHOD

Significance

In a social science like economics, historical method found its expression and application as early as in the middle of the 19th century through the writings of the German Historical School. Past knowledge is considered to be pre-requisite for present knowledge. This is the main argument for the adoption of historical method in present-day social research. Nothing happens in a social vacuum. In so far as anything has an anticipated history and natural development, past is causally related to the present. Although there is intertemporal change of situations, there are still certain orders and regularity in social matrix. These regularities are regarded as process-series sequence-pattern periodicities and cycles. It is said that history repeats itself. This, though not wholly true, is broadly valid for social phenomena. In order to appreciate these regularities and social influences, one has to resort to the historical method. Historical method is "the induction of principles through research into the past and social forces which have shaped the present."¹ In order to discover some basis for social activity, the method becomes genetic in character. The main objective of this method is to apply mind in the matter of various social problems by discovering the past trend regarding facts, events and attitudes, and by demarcating the lines of development of thought and action.

History and sociology are, in a sense, the two sides of the same

1. P. Young, *Scientific Social Surveys and Research*, p. 207.

coin. "When our attention is directed towards the uniqueness, the individuality of past social facts, when they interest us because of their importance for the unique evolution of man in his activities as a social being, in selecting the facts and in grouping them into a complex, evolving whole, we employ the historical method...We select our facts, not for their individuality or for the importance of their individuality for a complex whole but for what each fact has in common with others and the synthesis is not a common complex unique whole but a generalisation in which no trace of the individuality of the past social facts remains...Thus the work of the historian supplements that of the sociologists. The historian is interested in the quantity, in generalisation, in repetition."² A social researcher can only neglect history at the cost of great risk.

Essential Requirements for Application

History is the product of circumstances and environment. Therefore, unless the environment is known, historical facts and data cannot be fruitfully applied. To begin with, a good deal of social insight and historical orientation is necessary. Social insight, which implies studying of data with reference to environment, is necessary to bring about causal relations. The researcher adopting the historical method must study the cause and effects relations of historical events. The historical method requires experience not only in collecting data but also in finding out their relations and significance in the particular context. Since an environment is the product of different factors—economic, political, sociological etc.,—a researcher has to have knowledge of these disciplines.

History is a phase of social life. A researcher, must take up the analytical view in order to get perfect control over facts and the synthetic view of facts. He should be able to find out the relations between events and events, and between events and environment. It is necessary to make an objective approach both in discovering facts and interpreting them. But in order to be objective, the approach must be based on relevant, adequate and reliable data.

For applying historical method, the researcher should be familiar with the general field of his topic and be clear with regard to his own objective. A good deal of imagination is required to apply the historical method. Without imagination, history would produce disjointed and meaningless collection of data.

Probable Inference in History³

The statement that the present can be understood only with reference to the past is, however, not true. The nature of things must be known first, before the study of the things from the past takes place.

2. F.M. Fling, *The Writing of History—An Introduction to Historical Method*.
3. Cohen and Nagel, op. cit, pp. 323-344.

Knowledge of history can be achieved only through inference, the premises of which can be obtained by scrutinising the present material whose evidential value is determined by hypothesis which itself can be tested by current events. Knowledge of the past has no exclusive priority over the present. All this, then, points out that scientific method is also required in history. Historical evidence is never complete and conclusive and, therefore, the conclusion arising out of it is only probable. In history, hypothesis is necessary either to fill out the scanty material with suggestions of relation where it is absent, or to select the most significant fact out of plenty. However, the determination of the meaning of historical data must be roundabout. This is because the historian's witness can be questioned and made to answer. In so many cases, the truth of a historical proposition may not only be substantiated by independent witnesses, but also be verified by the calculable consequence which a past event has generated in the present. Historical propositions may also be conformed by the principles of social behaviour and natural sciences. Historical propositions should be so arranged as to form a coherent whole. Systematic theories to explain history are indeed essential. However, perfectly comprehensive theory, perhaps, cannot be achieved in human history. The theories of human history cannot be as perfect as those of natural sciences because of the complicated factors and subject matter of the former. They cannot be interpreted in deductive fashion and are, therefore, not capable of refutation and verification. Inferred historical facts are very deceptive, since there is no possibility of discovering the possible error. However, it cannot be denied that the present contains the past, because the consequences of the past are inherent in the present. The present is always merging into the past and past events are considered in the light of consequences they lead to. The responsibility of history cannot cease so long as events lead to consequences.

Limitations

For the successful application of the historical method, reliable and adequate data are required. The deeper is the past, the greater is the difficulty of obtaining the relevant facts. Secondly, the records are not always kept in order. Therefore, the researcher needs a great deal of patience to find out accurately his facts and materials. The documents are too dispersed, and all the data cannot be had from one institution only. Another limitation relates to the fact that the data have to be taken into the frame of the conditioning phenomena, otherwise their real significance would be lost. The follow-up of the conditioning phenomena is difficult because of the time-lag between the phenomena studied and the present situation. The determination of the exact nature of the past phenomena is not an easy task. By the very nature of historical procedure, it is not always possible to refute and verify the historical data and thereby their inferences. Thus, scientific method, in its entirety, cannot be applied in the case of historical method.

In historical method, calculation and measurement, as in quantitative method, are not possible. Thus, great caution has to be taken for the collection and interpretation of such data. The available historical records may be selective and may contain the subjective bias of the author. These may overestimate the events of secondary importance. However, the danger of selectivity is very great, since the observations are made very often by persons untrained in research.

Steps for the Application of the Method

Firstly, the choice of the exact problem is essential. Every problem is not amenable to historical research. The problem should be worthy of investigation in itself. The researcher in this field should be experienced and highly trained. Since the collection of data requires considerable time, the subject of investigation must be related to the time at the disposal of the researching hand. Pursuing of historical method involves, obviously, huge expenditure which every researcher cannot afford. Secondly, the important step is the collection of data. The relevant information is to be found out next by looking into the sources—both published and unpublished. The next task is to ascertain as to which are the official documents and which are not. One should study the published secondary literature related to the field of investigation. This would be helpful in finding out the correct sources. The third step is to study all the available material on the subject. If this is not done, the research becomes biased, incomplete and partial. While collecting, the data should be classified into primary, secondary and tertiary sources and be evaluated in terms of the source. Documents are helpful for the verification of certain events and in finding out the missing links in the social institution. But the documents themselves should be subjected to verification and test in order to prove their authenticity.

The Use of Documents

The nearer in time a document is to the period under investigation, the more believable it is likely to be, in general. Similarly, the more detailed the information, the more reliable it is. Official documents are to be preferred to the private documents. The greater the agreement between various records, the greater is the probability of the data being correct. Personal accounts and records are mostly subjective and, as such, they should be studied with great caution. But they may be useful as corroborating evidence. Contemporary documents should also be subjected to tests. Contemporaneity does not always make a document believable. Thus, selectivity becomes very helpful both in the cases of contemporary and non-contemporary documents.

Conclusion

It is essential to check and cross-check the data from as many sources as possible. It is important to arrange the matter into logical sequence and to reconstruct the situation. A proper reconstruction

of the situation requires knowledge and understanding of a large degree. The reconstruction of the situation is the first step towards the synthesis of facts. A successful application of the historical method requires careful, tolerant, sympathetic but critical attitude on the part of the researcher. In the words of Pauline Young, "historical data drawn from a variety of sources, judiciously chosen, critically examined and discriminatingly used, may constitute a fund of knowledge indispensable in understanding and generalising on community phenomena, the social milieu and social institution."

COMPARATIVE EVOLUTIONARY OR GENETIC METHOD

This method attempts to support the thesis of organic development according to the fixed stage. Comparative method is applied, generally, to the theory of biological evolution. In social anthropology, this method is frequently employed to show the evolutionary stages and forms of social institutions. Comparative anatomy becomes the basis of argument for organic evolution. This can be seen in the attempt to arrange plants and animals according to certain resemblances regarding anatomical structure. For instance, the tails of cows, monkey, buffaloes, dogs, etc. are arranged in such a series. It is the general conclusion that the "species have arisen in time in the order presented in the series".

We may examine the working of this method in social anthropology. For instance, the institution of marriage has passed through several stages, e.g., promiscuity in the very primitive stage, group marriage next, then maternal clan followed by paternal clan, and lastly, we have the individual monogamous arrangement of marriage which is considered to be the basic and most advanced stage of the institution of marriage. These stages or orders of the institution of marriage are discovered by studying the marriage patterns of some tribes. The prevalence of different stages of marriage in different tribes indicates a temporal sequence in such a fashion that stage first must have preceded stage second, which in turn is followed by stage third, and so on; and that a tribe in a certain stage at present must have passed through the earlier stage or stages.

However, temporal order or order in time, is not the same as logical order. A confusion between these two orders was created by the uncritical use of the comparative method by Morgan, Spencer, etc. Institutional forms belong to different historical series, each having a definite position in the tribal history where it is noticed. Therefore, unless we appreciate the evolutionary theory of stages beforehand, we cannot arrange the social institutions in a logical order, as required by the evolutionary theory. In other words, if we do not assume that the sequence of stages in each of the different tribes is identical, we do not have any evidence at all. But in assuming this,

we commit the fallacy of arguing in a circle, because this assumption itself is tantamount to the theory of social evolution. Another mistake is committed when superficial resemblances are taken for granted as significant similarities. For instance, we cannot be definite in saying that since all people have ideas, all people are similar. For, the forms of ideas may be very much different. Again, the act of killing human beings, for example, may be prevalent in different groups, but the motives may be so different that a direct comparison of group killings would not be of any significance. Formal ideas and actions, though alike broadly and generally, cannot often be compared because of the minute and fundamental cultural and psychological differences between them.

DESCRIPTIVE METHOD

The descriptive method is simple, and easily applicable to various social problems, particularly in developing countries. It is a fact-finding approach related mainly to the present, and abstracting generalisations through the cross-sectional study of the present situation.⁴ This method is mainly concerned with the collection of data. But since mere collection of data does not constitute research, unless the data are properly interpreted to find the causal connections and relations, the descriptive method, to some extent, is also concerned with the interpretation of data.

Significance and Importance

The descriptive method is more commonly used in social sciences, socio-economic surveys, job and activity analysis.⁵ But the method is also extensively used in physical and natural sciences, e.g. in measurement in physics, in dissection in zoology, in classification in biology, in the study of rocks in geology, etc. Sociological problems are generally descriptive. The objective of socio-economic surveys is to describe, analyse and interpret social and economic institutions, area or group with a view to drawing out generalisations which are either helpful to solve the problem directly or to guide other investigations. Job analysis takes note of the manpower available and the manpower required for different jobs in various professions.

However, all types of problems in social sciences cannot be subjected to the descriptive method. Mainly, the complex theoretical and philosophical problems are out of the purview of this method of approach. The descriptive method can be applied if the problem to be analysed fulfils certain criteria. Firstly, the problem must be capable

4. M.H. Gopal, *An Introduction to Research Procedure in Social Sciences*; p. 74.
5. E.B. Renter, "An Evaluation of the Subjective Methods of Sociological Research", *Journal of Educational Psychology*, 1935.

of being described and not merely argued about. For instance, international monetary institutions—their objectives, structures, techniques, failures and achievements etc., can be studied descriptively. But the choice of a particular theory does not depend on description but on reasoning, although the theory itself is descriptive. Thus, the question whether one or the other growth model is acceptable, is dependent largely on reasoning and, therefore, is not amenable to the descriptive method. Keynes' *General Theory* and Hicks' *Value and Capital* do not follow the descriptive method, but Hawtrey's *A Century of Bank Rate* does. At the present state of our knowledge, the conditions and problems of developing economies, mostly, can be made amenable to descriptive method.

In order to apply the descriptive method, the data should be accurate, objective and, if possible, quantifiable. This will make the data more satisfactory and reliable. But all situations and data do not fish out quantitative information. However, one must ensure that the descriptions are objective, adequate and accurate so that a detailed picture of the situation may be collected without any difficulty. Accuracy does not mean the discovery of every relation or aspect of the problem; it simply means the finding out as much detail as possible under given situations and presenting the details in an unbiased manner. Some problems are by nature quantitative and some are not. For example, the study of the wages of labour can give quantitative information, but the study of the functions of rural institutions will not.

Since the descriptive method wants to relate causally the collected facts, it is necessary for it to make comparisons between one situation and the other, and between different aspects of the same situation. Thus, situational comparability is an essential element of this method. But in order to be amenable to comparison, the situations must be similar. This is where the judgement and imagination of the researcher regarding different situations have to play their part. In order to present the continuity of ideas and to demarcate the line of solution, the researcher should relate the facts to time and place before any comparison is made. The researcher, after collecting the facts, should provide interpretations. He must provide the scope and direction for checking his own methodology and facts, and should also suggest the direction in which further research is necessary and possible. Here the descriptive method should demand at least three important things (i) an accurate and adequate bibliography relating to the problem studied, (ii) an elaboration of the applied methodology for the collection and analysis of facts and (iii) a list of the unsolved but relevant problems encountered by the researcher.

Limitations

Mere description of a problem does not constitute research. Research entails discovery of facts, and it is essentially creative. Every problem has its past, present and future. The description of a

problem is only one phase; it does not speak entirely of the problem. What is dangerous is an unprogressive conservative attitude which may also be reflected in the collection of facts. Another limitation arises out of the extreme tendency to over-use statistics. Partly, statistics is a descriptive tool; but it cannot always be helpful to find out causal relations in an accurate manner. Instead of being used as a servant, statistical techniques are sometimes used as a matter.

Scientific Method*

Method or Approach ?

The overall approach to research of any variety is what is generally termed as the "scientific method". Scientific method comprises three steps—*observation, hypothesis and verification*. However, these steps are applied both in the cases of physical and social sciences. This method is called the genus, and the different individual methods are the species. Scientific method is less of a method, but more of a general philosophy of research. There are as many scientific methods as there are different varieties of problems. According to Prof. Northrop, scientific methods are relative to the stage of enquiry and the type of problem.⁶ Different stages of enquiry may have different scientific methods, and the method which is scientific for one stage may not be so for another. In fact, there is no monism in scientific method.⁷ As there are multiplicity in sciences, there are multiplicity in rational methods. Prof. Caldin holds that there are several types of rational methods. Prof. Hook draws a distinction between scientific technique and scientific method. The former is the instrument available for any research and the latter is the special method of any particular science.

Profs. Cohen and Nagel regard the scientific method as the most assured technique for controlling things and establishing stable belief. It is based on systematic doubt, and it aims at discovering the actual facts and the rational inter-connection of facts. It wants to establish general propositions through weighing the evidence. Mehlberg points out that the problems which are not accessible to scientific method are meaningless problems. However, it is not the facts themselves which make science but the method by which they are dealt with. However, since a distinction is useful between approach, method and technique, it is rational to regard scientific method not as a method in the sense as historical, descriptive and other methods. As Prof. Marganan observes, scientific method, being highly elastic, can be made applicable to all domains of human activity where the discovery of truth is the objective.⁸ *Encyclopaedia*

* For further details, see the Section on Scientific Method (Infra)

6. F.S.G. Northrop, *The Logic of the Sciences and Humanities*, p. 19.

7. Litt, "Method in Science" in *Science and Freedom*, 1955, p. 141.

8. *Science and Freedom*, p. 147.

Britannica defines this method thus : "Scientific Method is a collective term denoting the various processes by the aid of which the sciences are built up. In a wide sense, any method of investigation by which scientific or other impartial and systematic knowledge is acquired is called a scientific method."¹⁰ However, the features of scientific approach are *mutatis mutandis* applicable to all methods. The pattern of scientific investigation, incorporating a number of methods, constitutes the concentric circles in the research procedure.

The scientific approach has two constituent elements—procedural and personal. They are described below :

Procedural Components

Observation, hypothesis and verification are the three procedural components in a scientific approach. Observation is based on data currently available. Observation depends on knowledge, material and personal hunches. Observation helps to build up hypotheses. It also helps as a technique of collection of data, thereby helping verification. The second step is the formulation of one or more hypothesis. A hypothesis is a tentative conclusion. The main function of a hypothesis is to guide the collection and processing of materials, and direct investigation. The third step is the verification of hypothesis and arriving at a generalisation. Verification is helped by analytical tools. The tools of collection and analysis are available techniques used for checking and counter checking. Tools help in the careful definition of the concepts and in the collection of the comprehensive data. Even in social sciences, statistical or quantitative tool is coming into greater use.

Personal Components

The researchers need imagination, analytical ability, resourcefulness, skill, persistence and independence. The capacity to find the heart of the problem is a part of the enquiry. The knowledge of the field of investigation is a facet of the personal component. Researcher's ability and attitude are more important than the method of approach. He should have an objective, scientific and unbiased view. He should have sufficient personal qualifications and professional training, apart from practical experience. The personal qualifications must enable the researcher sufficiently to assess the adequacy, relevance and value of the data. Personal quality also relates to integrity, honesty, truthfulness and sincerity of purpose. At every step, the researcher requires reasoning. There is a greater need for balance or poise between mental, physical and moral qualities. Poise gives the ability to see things in their true perspective. Ambition, interest and perseverance are very much required to go on successfully with research. In other words, a worthy researcher should possess the objectivity of Socrates, the wisdom of Solomon, the

courage of David, the strength of Samson, the patience of Job, the leadership of Moses, the strategy of Alexander, the tolerance of the carpenter of Nazareth, and above all an intimate knowledge of every branch of the natural, biological and social sciences.

SCIENTIFIC METHOD*

Meaning

A scientific method is the way in which one can test opinions, impressions or guesses by examining the available evidence both for and against them. It is simply the pursuit of truth which is determined by logical considerations. Scientific method is the most assured technique for controlling a host of things and establishing stable belief.

Essentials of Scientific Method

Scientific method aims at discovering facts. But facts cannot be discovered without some reflective enquiry. Every fact is initially nothing but some proposition or problem. At every stage of enquiry hypothesis is necessary. Hypothesis is regarded as a suggestion of possible conditions between imagined fact and actual fact. The deductive elaboration of hypothesis is not the only function of scientific method. Scientific enquiry has to determine which of the possible explanations is in best conformity with the facts. Every enquiry depends first on the probable inference : further enquiry decreases or increases the probability.

Scientific enquiry is based on systematic doubt. When facts demand, science may abandon a theory. When new and more probable facts are found, the earlier facts containing a theory are given up. Verification of theories at a particular point of time is only approximate.

When a science proceeds in this way, it becomes progressive. Science aims at establishing a systematic interlinking of facts. The evidence for a proposition may be collected from its own verifying instances, or from the verifying instances of other relevant propositions. This systematic character of scientific theories is responsible for high probabilities of their propositions.

Scientific method is self-corrective in nature. It depends on the methods of developing and testing hypothesis. The method of enquiry itself may be tested and modified. Since scientific method is based on the most probable inference at a particular point of time, a scientific theory is more probable than any other alternative theory. The method of science depends on evidence which is collected from

* This Section is entirely based on Cohen and Nagel's book, *An Introduction to Logic and Scientific Method*, Allied Publisher, 1968.

empirical material on the basis of principle. In the process of such dealings, the doubtful matters are detected and clarified.

Scientific theories are abstract in nature. A theory accepts only relevant matter, and rejects others which are either irrelevant or have a minor or insignificant influence on the theory.

Scientific explanation rests on certain laws which seek to explain events of particular types. Laws are the consequences of more comprehensive theories, and may themselves be checked. However, there may be different types of theories. For instance, physical theories depend upon hidden mechanism (models), mathematical or abstractive theories make use of relations abstracted from the phenomena actually observable, and a synthesis or fusion type of theory works with both kinds of theories.

Nature of Scientific Method :

The nature of scientific method depends upon the nature and objective of a particular science.

There are, broadly, two methods of science :

(i) Technical (Technological) and (ii) Logical.

(i) *Technical Method* : For proper observation and experiment, a science, for its investigation, develops certain technological relations or facts against which the observed facts are considered. Technical methods may imply the use of certain instruments. The more developed the technical method, the more exact a science becomes in handling data required for experiment. The use of technical methods makes a science progressive.

(ii) *Logical Method* : Since science is a systematised knowledge, the importance of the method of reasoning or logic can hardly be overestimated. Logic is the science of reasoning. It formulates conditions through which the validity of reasoning may be tested. Reasoning consists of arriving at a conclusion from certain premise or premises. The process of deducing a conclusion from a premise is called inference, which is nothing but derived knowledge. All knowledge consists of assertions or propositions. Inferences is a proposition which is derived from some other proposition. A valid inference is one in which the conclusion follows reasonably from the premise. For ascertaining a valid conclusion, a science should depend on logical method. Scientific method is, therefore, the persistent application of logic as the common feature of all systematic and reasoned knowledge.¹¹

Formal Logic

Logic is an instrument of reasoning; and its character is formal.

11. Cohen and Nagel, *An Introduction to Logic and Scientific Method*, Allied Publishers 1968, p. 192.

Logical validity cannot ensure the correctness of the subject-matter of science. Logic is more like Grammar which deals with the correctness of the form or the structure of language, but not with the correctness of the matter of the language. Similarly, logic studies the form or structure of reasoning and formulates the conditions for the validity of reasoning, but it does not and cannot study the material correctness or incorrectness of a premise or a conclusion. Logic is formal because it studies the form or structure of reasoning.

Pattern of Scientific Method :

The pattern of scientific method consists of :

- (1) Hypothesis
- (2) Testing of Hypothesis
- (3) Observation and Experiment
- (4) Formulation of Laws
- (5) Construction of Theories
- (6) Testing of Theories

Logic and Scientific Method

Logic involves reasoned knowledge : and all sciences are applied logic. The universal feature of science is its general method which consists in the persistent search for truth. But the search for truth depends on evidence, the determination of which we call logic.

We believe in a thing because of many factors : tenacity, authority; superstition, intuition etc. But seeing or mere believing is not believing in the true sense of the term. All the above factors are not free from human caprice and willingness. Scientific method is an enquiry to ascertain the validity of beliefs, hypotheses and propositions through factual evidence. Such a method having objective connections, should, then, be found reasonable, because it can be tested. Scientific method is flexible and encourages doubts, and what is left after doubt is always supported by the best available evidence. When new doubts or evidence arise, scientific method incorporates them as an integral part of the existing body of knowledge. The method makes science progressive, because it is never too certain about its results.¹² Formal logic is helpful in scientific method in that it devises ways of formulating propositions correctly and explicitly so that their possible alternatives become clear.¹³ When alternative hypotheses are framed, logic develops its consequences which, when compared to observable phenomena, can be the means of testing the validity or otherwise of a hypothesis.

12. *ibid*, p. 195.

13. *ibid*, p. 196.

Value and Use of Scientific Method

Possession of knowledge is a universal human urge. But the desire to know is not often strong enough to sustain a critical type of enquiry. Institutions of knowledge cannot give any proof that contrary institutions are wrong. Scientific method is concerned with verification of the acquired knowledge. It finds out some order in which things are related together. The conclusion which is arrived at by the scientific method has an objective validity. The objective nature of the scientific method is its greatest quality. Scientific method is the only way to increase the general body of tested knowledge and to eliminate arbitrary and ambiguous opinion. Scientific method springs from the desire to acquire truth, and when this desire is very strong in a community, the progress of scientific method becomes rapid and smooth. The method, however, may not always lead to the final destination of truth, but "enables large numbers to walk with surer step". It certainly minimises the dangers associated with novelty, adventure and uncertainty. It lays down policies and standard of moral judgement with a broader outlook than those of organic response or wild stimulus. It strengthens the love for truth and courage for overcoming illusions. It settles differences in a rational way, which is appealing to all. It is beyond a narrow outlook and subjective elements which are sometimes petty. It unites men through its noble and rational procedure. "Because it requires detachment, disinterestedness, it is the finest flower and test of a liberal civilisation".

Difficulties in the Use of Scientific Method in Social Sciences

Some people argue that scientific method is more applicable to physical or exact sciences and it cannot be applied to social sciences which deal with human behaviour. Those holding this opinion point out the following difficulties in use of scientific method :

1. Human behaviour is complicated, subtle and varied. Therefore, it is very difficult to categorise human behaviour.
2. When human behaviour is studied and analysed by other human beings, the personal characteristics of such human beings come into the picture and distort the analytical facts.
3. Different aspects of human behaviour are psychological in nature, and as such, do not admit of measurement.
4. Human behaviour is not uniform and predictable. It is, more often than not, uncertain. All people do not behave in the same way in similar circumstances. Similarly, one individual may behave differently under similar circumstances.
5. The choice or decision involving humans, which is essential for observing human behaviour for the use of the method of

experiment, becomes difficult. Thus, reliable scientific data cannot always be collected.

Scope

But today it is held that even in social sciences, which deal with human behaviour, the use of scientific method cannot altogether be ruled out. The difficulties are overcome in the following ways:

(i) Human society is progressing through predictions of human behaviour; and in most of the cases, predictions come to be true. The variations, if any, become a matter of degree. Under particular circumstances, most human beings behave in a particular way—the individual variation, however, is there, but class variations generally do not occur. Thus, there is nothing to prevent broad generalisation. A science progresses by making abstractions. The discovery of common features for general knowledge is an essential element of the scientific method. The finding of class-behaviour means the discovery of uniformity which represents the order of things. And predictions can be based on order or uniformity.

(ii) The personal prejudices of an observer of human behaviour in social sciences can be minimised with the help of some standard techniques developed for that purpose. In economics, the use of *numeraire* helps to serve such a purpose. The marginal utility of a thing to a consumer (which is essentially psychological) is presumed to be equivalent to the price which a consumer is prepared to pay for the commodity. Money serves as a measuring rod. Presently, standard techniques are being developed for the observation of, and experiment upon human behaviour, and for the collection and interpretation of data. The objective of such techniques is to eliminate the subjective bias in the analytical framework of scientific theories. In economics, mathematical tools are being used to successfully study human behaviour. Psychology, which is concerned with the study of mind, has developed many techniques for measuring I.Q., personality etc. Similarly, Criminology has developed, among other things, the lie detector which seeks to catch a particular aspect of human psychology.

(iii) In social sciences, difficulties in observation and experiment may be reduced to a considerable extent by making the enquiry confined to a particular class whose behaviour is taken up for study. If the analysis is carried on for the same situations, circumstances, environment, institutions etc., it can be broadly realistic and successful.

(iv) The existence of complex phenomena does not eliminate the possibility of using the scientific method altogether. Physical sciences (for example, nuclear physics) are sometimes conformed with complex situations, but scientific method is successfully used there¹⁴.

14. Goode and Hatt : *Methods in Social Sciences Research*, p. 3.

It is clear, therefore, that scientific method has ample scope in social sciences. It can be used, by and large successfully, in the study of social phenomena and in predicting human behaviour. But one must make a difference between the laws of physical sciences and the laws of social sciences. Laws of physical sciences are uniform and exact. A single negative instance would necessitate the revision of the physical law. But in social sciences, laws are statistical averages and express only tendencies; and as such, they are not exact or uniform.

Limitations of Scientific Method

Scientific method has the following limitations :

1. Scientific method involves abstraction.
2. Scientific explanation is never complete. At every stage, there are some basic principles which remain unexplained in social sciences.
3. The conclusions arrived at by scientific method are not final. They are only relative to observed phenomena, facts discovered and reasoning developed.
4. Sciences have limited scope. Each science is concerned with a particular area and is based on certain assumptions.
5. Superstitions, cherished beliefs etc., are hostile to the growth of scientific method. Institutionists, authoritarians, fictionalists and mystics often undermine the respect for scientific method.
6. Formal procedures are fruitless. Definitions and formal distinctions are not often used properly; and statistical informations may be irrelevant and inconclusive.
7. Scientific judgement is difficult, and sometimes impossible, when situations demand immediate action.
8. The growth of scientific method in a society where there is no desire for truth, or freedom for the expression of intellectual doubt, is surely hampered. "Fear of offending established dogmas has been an obstacle to the growth of astronomy and geology and other physical sciences."
9. The necessary time for reflection, and material for experiments are often lacking for the proper development of scientific method.
10. Scientific researches in social field are often in the hands of those who cannot always oppose the established opinion or taboos.
11. No scientific method can guarantee certainty of achieving the goal and can prevent human life from being an adventure.

The Abuses of Scientific Method

Fallacies of Reduction : Science analyses objects into their constituent elements. But sometimes a misconception is formed that science identifies objects with their elements. This gives rise to two wrong notions : (i) that science denies the reality of connecting links or relations, and (ii) that science is a falsifications of reality. The former mistakes arise when, e.g. we regard scientific books as nothing but words, and society as nothing but individuals. Again, science is not a falsification of reality. It explains reality as a combined effect of certain elements in right proportions, e.g., water consisting of hydrogen and oxygen.

The Fallacy of Simplism or Pseudo-Simplicity : Science gives the simplest account of a systematic body of knowledge. But this does not mean that out of two hypotheses, the simpler is true. Truth cannot be identified with simplicity.

Some people, again, mistakenly argue that something, say production, is more fundamental to another, say, consumption. This is erroneous, because there may be two factors, which continually modify each other. Such an error is known as the *fallacy of absolute priority*.

The Fallacy of Exclusive Linearity assumes that a number of factors are so related that a linear series may be formed. This can be noticed in the attempts made by Kent in arranging human faculties.

The Fallacy of Initial Prediction presupposes the readily known feature of a thing to be its ultimate nature.

The Fallacy of False Opposition or Disjunction is a special form of simplism. It denies disharmony or conflict if there is some harmony of interests; and it denies harmony of interests if there is conflict and disharmony. There is the erroneous logical assumption that all alternatives are mutually exclusive. There may be conflict between labour and capital in the matter of sharing of product, but there is similarity of interests in the matter of protective tariff against a foreign industry. The *fallacy of false disjunction* involves the argument that things cannot be constant if they change, and *vice versa*. However, it is obvious that there is no change without some constancy and no constancy except relative to change.

It is wrong to assume that abstract is unreal. Abstract sciences do not unfold the whole of reality; but they are not unreal.

The Fallacy of Exclusive Particularity assumes that a "term which stands in one relation within one context cannot stand in any other relation within the same or other contexts". It is assumed that if a person is honest on one occasion, the same person cannot be dishonest on other occasions. This is, however, a false idea.

A dangerous fallacy is committed when it is thought that because a certain theory can fully explain a problem, every other theory on that problem is false.

Another form of *fallacy of simplism or false economy* is the confusion between necessary condition and sufficient condition. Both are required to prove a phenomenon adequately. Change in demand may be a necessary condition for a change in price, but never a sufficient condition, which may be provided by cost of production, and other factors.

The Genetic Fallacy: Temporal orders of history cannot be deduced from logical order. The evolution of historical events do not conform to particular logic. It is an error to suppose that an actual history of any science can take the place of logical analysis of its structure. Science is concerned with human knowledge; but the subject matter of a science is something which existed even before human knowledge. The temporal order is not, however, the same as the logical order.

Hypothesis

Meaning

A hypothesis is a tentative generalisation, the validity of which has got to be tested. A hypothesis, at its initial stage, may be an imagined idea or mere guess. A hypothesis is based on accumulated previous knowledge. A hypothesis is made in order to find out the correct explanation of a phenomenon through investigation. On the basis of the hypothesis, facts are observed and collected. When, by verification, the hypothesis is found to be true, a theory is obtained.

Functions of Hypothesis

1. The most important function of a hypothesis is to adequately explain all the facts connected with the hypothesis.
2. It enables us to direct enquiry along the right lines. It suggests experiments and observation. It helps to collect necessary evidence in order to discover the order of nature.
3. Hypothesis determines the method of verification as well as the procedure for enquiry. Hypothesis limits the scope of enquiry to a manageable area, because, instead of random collection of data, it enables us to search only for relevant facts. Therefore, it leads to economy of time and money.
4. It leads to the discovery of laws. It explains facts and laws, and thus seeks to verify knowledge.
5. Hypothesis leads to conclusion which is sometimes very significant for the advancement of knowledge. The significance of an object or event can be determined by a hypothesis.

Conditions for a Valid Hypothesis

1. The most important condition for a valid hypothesis is that it should be empirically verifiable. A hypothesis should be compared with the facts of experience directly or indirectly. A hypothesis has

ultimately got to be confirmed or refuted; otherwise, it will remain a mere supposition.

2. A hypothesis must provide answer to the problem which initiated enquiry. A false hypothesis is not always useless. It may encourage further investigation and attempt to find out relations among facts and thereby, may increase the evidence for other theories.

3. In case we have more than one hypotheses, we should prefer the one which has a strong power of predictability and which can explain the consequences.

4. If there are two hypotheses on the same problem and if they can be equally confirmed by evidence, the simpler hypothesis is generally chosen. A hypothesis is simpler than other, if the first is more general in nature and has fewer assumptions and a smaller number of independent elements. But simplicity should not be confused with familiarity. A new and unfamiliar hypothesis should never be adopted merely for its simplicity.

5. A valid hypothesis generally does not go against the traditionally established knowledge. But a hypothesis may not always be invalid, if it goes against well-established knowledge; for the traditional knowledge may itself be wrong.

6. A hypothesis must be clear, definite and certain. It should not be vague or ambiguous.

7. A valid hypothesis suggests an explanation which appears reasonably true in the present state of knowledge. A fanciful idea or an absurd imagination does not make a valid hypothesis.

Formulation of Hypothesis

The formulation of hypothesis presupposes some problems for which enquiry is necessary. If there is no problem, no enquiry is needed, and there would be no necessity for a hypothesis. A satisfactory solution of any problem requires that the irrelevant facts be eliminated from the relevant facts. The formulation of hypothesis gives the direction in which the facts are to be arranged. We cannot go forward unless we begin with a suggested explanation of the phenomenon. This suggested explanation is called hypothesis.

However, there is no definite set of rules which can be laid down for the formulation of hypothesis. Partly, it is a matter of hitting upon an idea on some problem. The people with discerning minds are more capable of doing it. According to Stebbing, "every hypothesis springs from the union of knowledge and sagacity."¹ Previous knowledge of the field of enquiry plays a significant part for the formulation of hypothesis. In directing an enquiry, a hypothesis must

1. L.S. Stebbing, *A Modern Introduction to Logic*, p. 304.

take some facts as significant. A relevant hypothesis expresses determinate modes of connections between a set of facts, including the fact investigated. However, "in the absence of knowledge concerning a subject matter, we can make no well-founded judgments of relevance".

The deductive development of a hypothesis must follow from its formulation. Therefore, scientific procedure in this regard plays an important role. However, one must be fully acquainted with the facts and theories already existing in respect of the phenomenon with which one is engaged. The possession of such knowledge depends to a great extent on one's experience and insight.

Analogy and Formulation of Hypothesis

Analogy implies similarity. If previously established knowledge can be used in hypothesis, analogy must be noted and exploited. Previous knowledge contributes towards the formulation of hypothesis through analogies. Resemblances or analogies should be noted between the facts we are attempting to explain, and some other facts, the explanation of which is already known. But all analogies are, however, not significant.

However, we do not always start with explicit analogies. We may start with vague resemblances; and then by careful enquiry, we may develop an explicit analogy in structure or function. At the time of formulation of a hypothesis, analogy is not always considered. Nevertheless, a hypothesis is generally satisfactory when it has some structural analogies to other well-established theories. In the formulation of a hypothesis, it is difficult to meet this condition. The analogy of a hypothesis to others is helpful for the systematic simplicity of our knowledge. It is really an achievement if we formulate hypotheses analogous to others. Analogy makes the interpretation of a hypothesis easy.

Types of Hypotheses²

There are mainly two types of hypotheses: (i) Crude and (ii) Refined. A crude hypothesis is at the low level of abstraction. It indicates the kind of data to be collected, and it does not lead to higher theoretical research. The refined hypothesis is more significant in research. Refined hypotheses are of three types. The simple level hypothesis indicates merely the uniformity in social behaviour. It does not involve much verification. A complex ideal hypothesis is at higher level of abstraction. This hypothesis examines the logically derived relations between the empirical uniformities. This type of hypothesis is useful in developing tools of analysis. It provides constructs for further hypothesising.

2. See, Goode and Hatt, op. cit, pp. 59ff. And M.H. Gopal, *An Introduction to Research procedure in Social Sciences*, pp. 119-20.

Another type of refined hypothesis is very complex. It is concerned with the interrelations of multiple variables. For example, in order to study family planning and human fertility in backward countries, a number of complex factors, such as wealth, religion, culture, tradition, health, etc. have to be considered.

Forms of Hypothesis

(i) *Hypothesis concerning Law*: This explains how an agent works to produce a particular effect or event.

(ii) *Hypothesis concerning an Agent*: The law of operation of an agent is known, but the agent which is working to produce an effect may not be known. This hypothesis is framed to find out agent.

(iii) *Hypothesis concerning Collocation*: Collocation means an arrangement of circumstances. When a hypothesis is made relating to the circumstances necessary to produce a phenomenon, it is known as a hypothesis regarding collocation.

(iv) *Descriptive Hypothesis*: It describes the cause and effect relationship of a phenomenon.

(v) *Explanatory Hypothesis*: It explains the happening of a phenomenon. It reconstructs the situation by extrapolation and arrangement of facts.

*Null Hypothesis**: Null means zero. When a hypothesis is stated negatively, it is called a null hypothesis. The objective of this hypothesis is to avoid the personal bias of the investigator in the matter of collection of data. A null hypothesis is used to collect additional support for the known hypothesis.

Verification and Proof of Hypothesis

Verification of hypothesis means the testing of the truth of the hypothesis in the light of facts. For verification, there must be the agreement between the inference of the hypothesis and the observed facts. The greater the agreement, the stronger is the hypothesis. Direct verification means the direct appeal to the fact of experience through simple observation or experiment. Where a hypothesis cannot be directly verified, it should be verified indirectly. In indirect verification, the consequences deduced from the hypothesis are compared to facts. If there is an agreement between consequences and facts, a hypothesis is verified. If facts agree with the hypothesis and, there is no contradictory fact, the hypothesis is verified.

In order to prove a hypothesis, it is essential first to verify it. However, verification is not conclusive proof. Thus, something more is necessary. A hypothesis must adequately explain all facts for

* See Ch. 21 the Section on *Analysis and Interpretation*.

which it has been made, and it must be the only hypothesis to do so. It must also explain all related facts, and it should have the power of prediction.

Sometimes two or more hypotheses may explain facts. Then, in order to know which one of them provides the real explanation, we take a crucial instance. This can be found out by observation or by experiment. A crucial instance is an instance which can only be explained by one of the contending hypotheses, and not by the other. This instance not only confirms a hypothesis, but it also negates the other. Suppose that a hypothesis is that X has committed a theft, another hypothesis is that Y has committed the theft. In course of investigation, it is found that X was present at a very distant place at the time when the theft was committed. Then, this is a crucial instance. However, disproving and eliminating its rival hypothesis does not imply that the original hypothesis is proved. Elimination of its rival hypothesis or verification of a hypothesis only indicates that the original hypothesis is more probable. However, a crucial instance obtained by experiment has a greater value for the proof of the hypothesis as compared to the crucial instance obtained by simple observation.

Hypothesis, Theory, Law and Fact

Hypothesis, Theory, Law and Fact are inter-connected. At the first stage of enquiry, a hypothesis is made, which is only a tentative supposition or guess. When a hypothesis is verified and found to be true, it becomes a theory. This theory, when it works satisfactorily and is proved, is generally accepted. It then becomes an instrument of further explanation and prediction. At this stage, the theory becomes a law. However, these stages are not very distinct, marked or definite. A fact is anything which is there or which can be conceived of. It is a concrete event of experience. Facts may be external or internal (of mind). External facts are perceived by our sense organs and internal facts are known by our minds. Well-established facts are sometimes regarded as laws. A science begins with facts and ends in facts. As concrete experiences, facts suggest hypothesis. The hypothesis ripens into a theory—a theory into a law, and the law becomes so familiar that it becomes a fact.

Uses of Hypothesis

1. Hypothesis forms the starting point of investigation.
2. Hypothesis makes observation and experiment possible.
3. Hypothesis is an aid to explanation.
4. Hypothesis makes deduction possible.

Deduction and Induction

Deduction

Deduction is the process of drawing generalisation, through a process of reasoning on the basis of certain assumptions which are either self-evident or based on observation. In deduction, we deduce generalisations from universal to particular. Deduction can give conclusive evidence. Depending upon the premises, every deductive reasoning is either valid or invalid. The main task of deductive logic is to clarify the nature of relation between premises and conclusions in valid arguments. It is concerned with the working out of logical implications between propositions. Let us consider an example:

All men are mortal.
John is a man.
∴ John is mortal.

Here, the conclusion follows from the two premises logically. Therefore, it is valid. Whether a proposition follows from another proposition or not, depends upon the form or structure of the two propositions. Let us take another example:

Some men are honest.
John is a man.
∴ John is honest.

Here the reasoning is not valid, because the conclusion does not automatically follow from the premises. The structure or the form of reasoning here is not valid.

Logical implication does not depend upon the material truth of the premises. The premises may be materially false, but yet the reasoning may be correct. Deductive reasoning does not wait to examine the material truth of the propositions. Let us take an example:

If Bhutan was a democracy and no democracy had any kings, it follows that Bhutan had no king. The falsity of the proposition, "Bhutan was a democracy" does not prevent us from drawing certain logical implications.

Logical implication, involving deductive reasoning, is formal in the sense that it holds between all propositions, provided they stand each other in certain relations. A form implies something where different objects agree, so that the objects may be varied, but the form remains the same. Let us take another example:

John is an adult.
All adults are eligible to vote.
∴ John is eligible to vote.

Here, all the peculiarities of John are not brought in the argument. The fact that he is adult is sufficient for the argument. And, any name can be used instead of John, but the argument will still be valid. Deductive reasoning can be helpful in studying compatibility or incompatibility of different propositions.

Induction

Induction is a process of reasoning whereby we arrive at universal generalisations from particular facts. Induction gives rise to empirical generalisations, and is opposite to deduction. Induction involves a passage from observed to unobserved. Induction involves two processes—observation and generalisation. If, in a number of cases, it is observed that educated girls have got expensive habits, one may conclude that all educated girls have got expensive habits. This is the simplest kind of induction, and is called *induction by enumeration*. But scientific induction is based on known causal connection. Induction by enumeration gives us only probable conclusion, but scientific induction gives us certain conclusions.

A *perfect induction* is the process of establishing a universal proposition by an exhaustive enumeration of all the instances of the type covered by the universal proposition. Perfect induction is not opposite to deduction; but on the other hand, it is an example of deduction. The conclusion in perfect induction is arrived at by strict syllogistic reasoning. But since in perfect induction there is really no generalisation and there is no passage from observed to unobserved, it is not sometimes regarded as induction in the true sense of the term.

Intuitive induction is the process of arriving at a conclusion from intuition and not from reasoning. It may be intuitively known that a particular patch of red is darker than a particular patch of pink. Here, the conclusion is direct and is based on perception which may be beyond any justification. In intuitive induction, no process of

inference is involved. Therefore, there can be no logic of intuitive induction. Intuitive induction is not also antithetical to deduction.

However, induction may be regarded as a method by means of which the material truth of the premises is established.

Induction (Generalisation) in Mathematics

Since mathematics is a deductive science, apparently, there cannot be anything like mathematical induction. But in fact, there is a method of mathematical induction which is purely a demonstrative method. The principles of mathematical induction may be discussed below:¹

If a property belongs to the number 1, and if and when it belongs to n , it can be shown to belong to $n+1$. Then, it belongs to all the integers. This theorem can be demonstrated. For all integral values of n , $1+3+5+7+\dots(2n-1) = n^2$

This is true when $n = 1$. But if it holds for the integer n , then it also holds for $(n+1)$

$$1+3+5+7+\dots(2n-1) = n^2 \dots\dots(i)$$

$$1+3+5+7+\dots(2n-1) + (2n+1) = n^2 + (2n+1) = (n+1)^2 \dots\dots(ii)$$

(i) and (ii) have the same forms. Therefore, if the theorem is true for the integer n , it is also true for $(n+1)$. Now it is true for $n+1$. It is true, therefore, for $n=(1+1)$ or 2, and so on. Here, the proof is formal and deductive. It has no appeal, as Cohen and Nagel assert, to experiment. However, mathematical induction is a part of the very meaning of inductive (finite) numbers.

Generalisation brings about changes in the meaning of words. In mathematics, the same thing has happened in the case of modern generalisation of numbers. Number, traditionally, was confined to integers. The abstract nature of integers can be expressed by means of a set of propositions indicating the nature of operations and relations between the operations. If we do not enlarge our conception of number, the inverse operation of division cannot be performed. For instance, there is no integer x such that $x \times 5 = 7$. Consequently, fractions had to be introduced. They are also called numbers. Thus, the area of number was increased in the interest of continuity and generality. Fractions is evident in the law of the series. However, according to Mill, this is no proper induction.

Distinction between Deduction and Induction

1. In deduction, we deduce generalisation from universal to particular, but in induction we arrive at universal generalisations from particular facts. Therefore, sometimes deduction is thought to be opposite to induction.

1. Cohen and Nagel, *op. cit.*, p. 148.

2. The propositions from which deductions are made are assumed. But in induction this is not the case. Induction is concerned with discovering facts and relations between them. Observed facts provide the basis of induction, but they are not relevant for deduction.

3. Deduction is not concerned with the material truth of the premises; but induction is concerned with the establishment of the material truth of universal propositions.

4. In deduction, the conclusion only seeks to unfold what is in the premises. It does not go beyond premises. The conclusion in deduction, in other words, is never more general than the premises. But in induction, the conclusion goes beyond the premises or, what is in the data. Therefore, in induction, the conclusion is more general than the premises.

5. Deductive method gives us conclusions which are certain; but the conclusions of the inductive method are only probable and not always certain. This is so because the conclusion in deductive reasoning follows from the premises logically, or it is implied in the premises; but in inductive method, conclusion is not implied in the premises. Thus, the conclusion is certain, if we say that since all men are mortal, and Ram is a man, Ram is mortal. But the conclusion is only probable or uncertain, if we say that since some educated girls have expensive habits, all educated girls have expensive habits.

Merits of Deduction

1. It is a simple and easy method which is not time-consuming and expensive.

2. This method leads to accuracy and precision in generalisation because it makes use of logic, and mathematical tools of analysis. If the premises are true, we can easily get a true conclusion.

3. In a social science, like economics, where there is limited scope for experimentation, this method becomes the only available method for the development of the subject.

Demerits of Deduction

1. It is harmful, when universal validity is claimed for the generalisation arrived at by deduction, particularly, when the premises are incorrect or partially correct. If policy prescriptions are based on deduction, the consequences may be dangerous. The deductive "arm-chair" analysis should be taken with caution and care.

2. If the assumptions upon which deductive reasoning is based are untrue or partially true, the inferences drawn become automatically beyond truth, therefore having no operational validity.

3. Deductive method is abstract. If a large dose of abstraction

is used in theorising the result is the creation of "intellectual toys" and useless "implicit theorising".

Merits of Induction

1. Inductive generalisations are based on observed facts and realistic foundation, and as such, they are precise and accurate.

2. Inductive method is scientific in character. Some of the important theorems of physical and social sciences have been developed through this method.

3. Inductive method underlines the relativity of laws or generalisations. It points out that a particular generalisation is valid under particular circumstances.

4. Induction supplies the universal premise and is helpful in finding out material truth.

Demerits of Induction

1. It is a time-consuming, expensive and complicated method.

2. It often leads to hurried and wrong generalisation.

3. The collection of data for induction is a complex job. An investigator using this method requires high degree of competence and training, besides sophisticated tools of analysis.

4. Induction is not fruitful without deduction. Without deduction, induction becomes destructive and, produces only a mass of unrelated and unconnected facts.

Deductive-Inductive Method (Logical Positivism)

It is wrong to think that deduction and induction are opposite to each other. We have already seen that pure and intuitive inductions are not at all antithetical to deduction. In general, not all the premises required logically in induction, are known to be true. The specific problem of induction is to determine as to what extent the samples are fair. The proper contrast is not between deductive and inductive inferences, but between inferences which are necessary and inferences which are probable, because the evidence for universal propositions can never be more than probable.²

In sciences, the two methods are often used side by side. The combination of the two methods is known as deductive-inductive method, or logical positivism. It is now increasingly recognised that analytical (deductive) studies must be corroborated by empirical (inductive) studies. For analytical work, empirical study is regarded important for many reasons. The empirical generalisations can become the basis, and provide us the rationale for analytical works.

Similarly, analytical studies are considered to be important for empirical research. Empiricism becomes meaningless unless it is guided by some principle, theory or analysis. Deductive-inductive method can be used in the indirect verification of hypothesis. When hypothesis cannot be compared directly with facts, then conclusions are deduced from the hypothesis, which are compared with the observed facts. When science discovers a law on the basis of observed facts by inductive generalisation, it can be demonstrated that the facts are deducible from the law. In deduction, certain propositions are deducible from the axioms (unproved assumptions); similarly, a scientific system is a form of deductive system in so far as the various laws are deduced from certain basic assumptions.

Pure deduction and pure induction are not meaningfully possible. A scientific method, which is perfect, has to be a marriage between the two. Deduction and induction are complementary rather than competitive. Both of them are needed for scientific thought as the right and left foot are needed for walking.³

Observation and Experiment

Observation and experiment jointly become the basis or the material grounds of induction. The material truth of an inductive reasoning can be established by the processes of observation and experiment.

Meaning of Observation

Observation means seeing things with a purpose. It consists in collecting the facts which are in the direct knowledge of the investigators. Observation is perception with a purpose. That is, observation is regulated perception. In observation, only the relevant things are taken into account. Therefore, it is essentially selective. Observation is the process of acquiring knowledge through the use of sense organs. The observation of mental states, e.g. love, hatred etc. is called introspection. Observation, however, is not the same as unconscious inference. Observation is the knowledge directly gained through sense organs. But inference is the process of passing from a known proposition to an unknown or implied proposition. Thus, inference is indirect knowledge. Sometimes, wrongly, hasty inference is confused with observation. This gives rise to a fallacy or malobservation. Interpretation which is essential for observation, is not direct knowledge but is derived and inferred. Sometimes perception also is based on interpretation derived from indirect knowledge or experience. Thus, observation involves an element of inference.

Components of Observation¹

Observation has three components, e.g., sensation, attention and perception. Sensation is derived from sense organs. The accuracy of observation depends, to a great extent, on the power of the sensory organs, like eyes, ears, nose etc. Attention is related to the ability to concentrate on the subject matter of study. Perception enables the mind to recognise the facts by identifying sensations and drawing upon experience and introspection. The accuracy of

1. M.H. Gopal, *An Introduction to Research Procedure in Social Science*
p. 17.5

observation depends on knowledge and experience. However, initial knowledge sometimes may prejudice the observation. But it can be reduced by proper training and observer's cultivation of the habit of unbiasedness.

Types of Observation²

There are mainly two types of observation, e.g., controlled and uncontrolled. In uncontrolled observation, no mechanical aid is used, and the data is collected without standardising method. The investigator thinks that he knows more than what he actually observes. Thus, dependable facts may not be collected through this type of observation. In order to avoid the illeffects of this type of observation, controlled observation is introduced, which takes the help of mechanical instruments. It also uses the standardised method and tries to get representative samples.

Observation may be participant and non-participant. In the former type, the observer mixes himself and fully participates in the study by keeping himself inside the situation he is studying. The best way to know human beings is to study them by being one of them. Since participation minimises objectivity, it requires care, control and experience on the part of the observer to make a mental study of the situation.

Accuracy and Reliability of Observation

For accurate observation certain steps may be taken:

1. Formulation of the problem precisely and clearly.
2. Study of each item separately at a time.
3. Relation of observed fact with the problem at hand.
4. Study of the relevant facts—selectivity and objectivity.
5. "How, when, who, what, why and where" should be in the mind of the observer to answer while making observation.

The reliability of observation depends on three factors: (i) techniques and tools used, (ii) observed situation, and (iii) the quality of the observer.

The tools and techniques used in observation should be reliable and scientific. The units of observation should be homogeneous. The skill and measurement should be properly developed. There should be proper cross-checking. The selection of sample should be careful. The sample to be observed has to be representative. While observing situations, objectivity has to be maintained throughout. The observer should have relevant experience, knowledge,

imagination, maturity, alertness, unbiasedness and mental and physical fitness. The observed result should be written immediately after observation, and all observable behaviour should be categorised, so as to help proper understanding and analysis. The situation to be observed, and its actual dimension, should be clarified; the extent to which social context is to be permitted should be specified. However, as yet, there is no standardised procedure applying to procedural tools.

Conditions of Observation

Observation may be distorted by a number of factors—prejudice, haste, little knowledge and experience, conservatism etc. In order to have a scientific observation, all these possible errors should be cautiously guarded against. The observation should be careful, minute and patient. One should also guard against wrong observation (malobservation). Wrong observation arising out of physical causes has to be avoided by all means. The observer should be properly trained, and be capable of using his methods and tools properly. He should have sufficient knowledge and experience in the area of his investigation. The selection of relevant facts for the purpose of observation is also an important condition for making sound observation.

Observation requires, generally, three conditions to be satisfied : intellectual, physical and moral. The desire to know and unfold the truth is the main pre-requisite for observation. The reason and explanation of phenomenon come from intellectual faculty and introspection. Perfect physical capability and sound sense organs are essential for proper observation. The required moral condition is related to unbiasedness and impartiality. Subjective inclination, conservatism, superstitions, habits etc. should be entirely given up while making observations. There should be no pre-conceived notion or bias about that which is being observed for finding out the truth.

Fallacies of Observation

The fallacies of observation are of two types : *the fallacy of non-observation* and *the fallacy of malobservation*. The fallacy of non-observation is committed when the relevant facts are overlooked or neglected i.e. when some of the relevant facts remain outside the observation. There may be the overlooking or neglect of instances and/or that of the essential circumstances. We may overlook an instance which should have been observed because of its relevance. This may be due to superstitions, habit, pre-conceived notion etc. The overlooking of necessary circumstances may be due to the inadequacy of knowledge and/or unnecessary haste. The fallacy of malobservation arises out of the wrong interpretation of sense perception. When observation is mixed with unconscious inference, malobservation is caused. Malobservation is due to misinterpretation of our perception. It is the observation of something, which

makes it different from what it is, actually. For instance, at night one may observe a rope as a snake.

Observation in Social Sciences

In social sciences, observation is one of the important methods of acquiring knowledge. The observer has to take special care to ensure that his observation is more or less accurate. The observation of human behaviour is difficult in social sciences. A human being does not behave very often in the same way under similar circumstances. And different human beings behave differently under similar situation. Human behaviour or choice is highly volatile. There cannot be any single law or tendency to explain human behaviour. Human behaviour may be both rational and irrational, and these may be combined in the matter of personal volition or action. In social sciences, the technique of observation and the method of measurement are not ideally developed. As a result, observation is, to some extent, bound to be incomplete and inaccurate. Particularly, in social sciences, there is no standard procedure yet evolved to construct or apply procedural tools.³ In order to have both outside and inside views, it is necessary, in social science research, resort to both participant and non-participant types of observational techniques. However, in social science research, observation plays a more important part than experiment.

Since human beings may behave in differently when they are aware that they are being observed, it is better to keep the observed persons unaware of observation. In order to find out the actual or normal behaviour of persons, the observer may be a participant without revealing his identity. However, participation may lead to the loss of objectivity. This, then, should be guarded against. But that does not mean that non-participant type of observation is not scientific. The operability of participant observation depends on the situation and the problem at the disposal. The Behaviourist School of Psychology lays a great emphasis on this type of observation as the best way to know human behaviour.

Experiment

When observation is arranged and controlled, it is experiment. In experiment, the phenomena are artificially reproduced; but the conditions under which they are produced are selected and already arranged. Then observation takes place. In experiment, we put questions to Nature for eliciting answers relevant for our purpose.

Distinction between Observation and Experiment

Observation is regulated perception; but experiment is controlled observation. In simple observation, the phenomenon to be observed

3. *Ibid*, p. 177.

is supplied by the Nature, whereas in experiment, the phenomenon is artificially produced. Observation means the finding of fact, but experiment means the making of fact. - In Observation, therefore, the circumstances of the phenomenon are beyond our control; whereas in experiment, the circumstances of the phenomenon are within our control. Observation, however, is not completely natural, since we have to make use of artificial, technical instruments; and experiment is not completely artificial, as we have to make use of natural power for the observation of the created phenomenon. Prof Stock observes that observation is passive experience, while experiment is active experience. In observation, we watch the natural events as they are without attempting to control them; but in experiments, we become more active in creating the conditions for the phenomenon to occur, and in controlling the circumstances of the phenomenon. However, observation is not wholly passive, since it requires active mental faculty to select the relevant facts. In fact, observation and experiment are, in a way, facets of the same process of study of events, finding their causes and explaining their occurrence. Observation is like a genus having two species—simple observation and experimental observation. In these two cases, events are studied, natural power is utilised, artificial instruments are used and mental and physical activity is shown. Therefore, "observation and experiment do not differ in kind but they only differ in degree."

Advantages of Observation Over Experiment

1. Experiment is not possible in all cases; but observation can be carried out for all possible cases. Experiment is sometimes impossible or dangerous, but observation is not so. The scope of observation is much wider than that of experiment.

2. The preparation for experiment are dependent on observation. Prior observation is a condition for experiment. Observation may go without experiment, but experiment cannot go without observation.

3. In observation, we can have reason and argument from cause to effect, and from effect to cause. That is, the argument may be forward or backward; but in experiment, it is not so. Experiment proceeds from cause to effect. In observation, thus, we can find out the cause of the effect, or the effect of the cause; but experiment only unfolds the effect, the cause being given.

Advantages of Experiment over Observation

1. In experiment, it is possible to isolate the factors involved in a phenomenon; but in simple observation, this cannot be done. This can be done by making one factor variable, and other factors constant. In simple observations, since the conditions are not controlled, factors cannot be varied and made constant systematically.

2. In experiment, we can easily reproduce the phenomenon and vary the circumstances indefinitely. But in observation, we have to

depend on Nature for the supply of appropriate instances. In experiment, we may have as many instances as possible; but in observation, we have got to wait for a favourable opportunity and depend on the mercy of Nature.

3. Since in experiment the circumstances are within our control, things can be examined with sufficient calmness, care and poise. But in simple observation, we may have to be in haste, lest the phenomenon disappears very quickly. The observer has to wait but Nature does not, in simple observation.

Experimentation in Social Sciences

Experimentation is extensively used in physical sciences; but its application is greatly limited in social sciences. Experiment cannot be perfectly carried on in sciences which deal with human behaviour. The behaviour of human beings cannot be controlled; and human behaviour cannot be subjected to laboratory test. The main features of experimentations, e.g. the isolation of factors, replication of the experiment and quantitative measurement, may be made applicable at least in some of the social sciences. In social sciences, laboratory experiment is rare; and there are difficulties in appreciating and observing circumstances. The hypotheses cannot be adequately tested. But some of the difficulties in experimentation in social sciences can be avoided by developing better tools and by improving the techniques.

Stages of Experimentation

The first stage of experimentation using trial and error method is applicable to a number of socio-economic problems. However, this stage is only a groping stage. This stage can be improved by controlling the situation, defining terms and concepts, and by introducing scientific measurement. In social sciences, field experiment is being utilised with considerable success. Here, "the investigator manipulates one independent variable in a real social setting." Experimentation in social sciences faces non-homogeneous and complex units where observation cannot be controlled. The difficulty of isolating disturbing elements puts a hindrance to the conditions of control. But despite the drawbacks, experimentation has become an essential part of social sciences. Prof M.E. Brunk observes that, "controlled experimentation has established itself as a valuable tool in agricultural economics."⁴

The Steps in Experimental Techniques

The first step in the application of field technique relates to the mentioning of specific objective, selecting the problem, design and method. The hypothesis, at this stage, should be stated explicitly in

4. M.E. Brunk, "Sample Surveys and Experimental Design", *Journal of Farm Economics*, May 1955, p. 232.

general terms. The next step consists in setting up the field experiment. The factors to be controlled must be assessed; the co-operation between the researcher and the subject must be set up; and scouting for information is required before any choice regarding setting is made. The next step is the choice of experimental design regarding its size, material, control groups etc. The choice of material should be based on the criterion of maximum possible accuracy. The basic problem of design relates to control. Control and experimental groups should be matched on all important factors. In cases where conditions cannot be standardised, the significance of the factors can be deduced through various devices of measurement, such as trends, extrapolations etc. Control is necessary to reduce variations. In some experiments, some variables may be eliminated. Undesired variations can be reduced by standardisation. A good experiment tries to maximise standardisation. The size of the controlling and experimental units, however, should be fairly small for easy handling.

The social sciences have developed a number of devices for improving experimentation. One such gadget aiming at improving measurement, plotting trends and extrapolating observation is sociometry. The social measurement technique is now attempting to give greater exactitude to the relationship between social referents and concepts. Attempts are being made to numerically measure the behaviour, to quantify the qualitative data, through improvements in the technique of measurement.

Limitations of Experimental Technique

1. The singling out of one social factor in a phenomenon for the purpose of measurement is difficult, because in any event so many factors are intermingled.

2. Control of factors sometimes is not possible, because some factors may be unknown and uncontrollable.

The difficulty may be overcome by randomisation which seeks to neutralise variations due to extraneous factors. But at the last stage of the experiment, the sample may not remain truly random. It is better to select several random samples as experimental and control groups. Selectivity vitiates the random character of the sample. One solution here is the adoption of the control group technique.

3. There are difficulties in interviewing the control groups. The remedy may be found in matching the control and experimental groups on as many points as possible.

4. The determination of the required level of significance of the differences between the experimental and control groups, is also fraught with difficulty. What difference can be taken as significant? There is the problem of value judgement. But the scientific criterion is the determination of the statistical test of significance. However, this requires a reliable and valid socio-metric scale.

5. Another theoretical difficulty relates to replication. In social science research, the scope for repetition is very small. Experimental studies are new, controversial, expensive and not thorough, in social sciences.

However, despite these limitations in social sciences, the scope of experimentation can be further increased and improved. The sensitiveness of experiments can be augmented by neutralising bias through random choice, by increasing the area of experiment, by repeating experiments on a longer scale, by improvement in quantitative technique and by refinements of technique. The interpretation can mainly be tackled by introducing statistical devices and, observation can be made more sensitive by the introduction of greater uniformity in material. But when all is said and done, it must be admitted that the technique of field experiment in social sciences is still in its infancy.

Some Experimental Designs in Sociological Research

Prof F.S. Chapin has suggested three experimental designs in sociological research.⁵ They are discussed below :

1. *Cross-sectional design* seeks to analyse the current problem by making controlled comparison through the procedures of selective control. It is an analysis of association between different social groups. An attempt is made here to make the experimental and control groups homogeneous, by the matching of measurements on selected factors. There may be identical matching, or there may be the equation of frequency distribution on a particular aspect or feature. The applied technique seeks to find out the statistical relationship by the computation of correlation co-efficients and the analysis of break-down and of partial correlation. The "analysis of association by cross-sectional design forces us to handle the data, and the matching process adds to our store of direct knowledge of the factors in the problem."

2. The *Projected design* tries to analyse the future from the present. This design is utilised to suggest the achievement of desired ends with respect to the social programmes. This can be done by means of a technique which separates the means-ends scheme from the impersonal cause-effect relations. On the basis of a set of assumed antecedent-consequent relationship, successive events can be explained. This design is a kind of association between factors having probability of occurrence. In this design, the factors are quantitatively elaborated first; then the time lag, if any, between the appearance of a factor and the reaction, is studied; and finally the concept of mean score on a reasonable scale is introduced to measure adjustments. However, social events cannot always be explained in terms of design, purpose and planning. This is so, because events are caused by so many factors—simple and complex, known and unknown.

5 F.S. Chapin, *Experimental Designs in Sociological Research*.

3. The *Ex-post facto design* attempts to trace out the prior cause from the present problem. It is an analysis from the present to the past. The design consists of the study of the same individuals at the present and at some prior period (or, the comparison of population of an area in the present or in the past). Here, the ordinary technique of induction is followed. The operations are simplified by control, through matching of several independent variables which are related to dependent variables. In this design, - the purpose of observation under conditions of control is to isolate the relationship between the main causal independent variable which is considered as the effect. However, in this design, the freedom of application in method and technique seems to be restricted because the facts are to be collected from the available past and present records only. Furthermore, the choice of causal and control factors also appears to be restricted because of the presence of only a handful of causal factors in this design.

6

Inference

Meaning, Nature and Type

Inference is the justified logical process of passing from one proposition to another proposition. In an inference, generally, more than one proposition is required. When inference is translated in terms of language, it is called argument. In an argument, the given proposition or propositions are called the premise; and the result, which is drawn out of the given propositions, is called the conclusion. Inferences are broadly classified into two types : deductive inference and the inductive inference. Conclusion in the deductive inference cannot be more general than, or cannot go beyond the premises; but conclusion in inductive inference is more general than, or goes beyond, the premises. Deductive inferences have been reclassified into two categories : immediate and mediate. In immediate inference, the conclusion logically follows from only one premise. In this inference, the meaning of the single proposition is made clear. Since immediate inference is a type of deductive inference, the conclusion here cannot be more general than the premise. In immediate, inference the conclusion is drawn, logically, from more than one proposition. When there are only two premises in a mediate inference and the conclusion follows automatically from them, such a type of mediate inference is known as syllogism.

Is Immediate Inference Inference ?

The traditional logicians, generally, at least a good many of them, like Mill, Bain etc. do not regard immediate inference to be inference proper. In the case of immediate inference, the conclusion does not reveal any new truth, but it only contains what is already asserted in the premise. The fact of the conclusion is either the very same fact or part of the fact asserted in the premise (i.e. original proposition). Therefore, in all these cases, there is not really an inference. This justified opinion of Mill is also supported by Prof. Bain. According to Bain, in immediate inference, there is no transition from a fact to some different fact; but there is merely the transition from one wording to another wording of the same fact. Unless there is the transition from a fact to some different fact, there cannot be any inference in the proper sense of the concept.

However, in immediate inference, the step from the premise to the conclusion is a minor or small step, but nonetheless it is not correct to point out that there is no step at all. Immediate inference spells out clearly the full implication of the given proposition, by making explicit what is implicitly referred to in the premise. It is true that the given or original proposition is known, but its full meaning or implications may not be known. Thus, immediate inference begins from something which is known and given, and it brings out something which is new and unknown.

Immediate inference may be of various types. Some of them are discussed below :

Conversion : It is a type of immediate inference in which there is a right transposition of the subject and predicate of a proposition. For instance,

No man is perfect (convertend)
No perfect beings are men (converse)

By conversion, A proposition leads to I; E leads to E; I leads to I; but O does not lead to any conclusion.

Obversion : It is a type of immediate inference where there is an alteration in the quality of a given proposition, the meaning remaining the same. For instance,

All men are mortal (obvertend)
No men are non-mortal (obverse)

By obversion, A leads to E; E proposition leads to A; I leads to O; O leads to I.

Let us consider an example,
Virtue is good
Vice is evil.

It is a case of material obversion. This inference is justified only on the basis of the matter of the proposition. Bain says that this type of inference is not of formal type. Here, the rules for obversion are not followed. It is, therefore, a material inference based on knowledge and experience, and does not come under the purview of deductive logic.

Oppositional Inference : It means the inferring of one proposition from another. There are four main types of opposition; e.g. subaltern, contradictory, contrary and sub-contrary. They are discussed below :

Subaltern : It is the relation existing between two propositions

which have the same subject and same predicate but which differ in quantity only.

Rules : If the universal proposition is true, the corresponding particular proposition is also true, but the converse is not true. (II) If the particular proposition is false, the universal proposition is also false, but the converse is not true.

Contrary Opposition : It is the relation between two universal propositions which have the same subject and same predicate but which differ in quality.

Rule (1) If one proposition is true the other is false, but not conversely.

Sub-contrary Opposition : It is just like the contrary opposition, but the only difference is that sub-contrary relation holds only between two particular propositions.

Rule : If one proposition is false, the other is true, but not conversely.

Contradictory Opposition : It is the relation between two propositions having the same subject and same predicate, but differing in both quantity and quality.

Rule : The truth of one proposition implies the falsity of the other, and vice versa.

Implication and Inference

Implication is the logical consequence or relation between propositions. The test as to whether there is a logical implication between one proposition and the other is the impossibility of the former being true and the latter being false. That is, if the proper proposition is true, the latter proposition cannot be false, if there is a valid logical implication. In the case of valid proof, the conclusion is implied by the premises. There is a valid inference of one proposition from the other, if there is an objective relation of implication between the first and the second propositions. Inference is a temporal process but implication is an objective relation between propositions. Therefore, they should be distinguished from each other. Even if the process of inference from one proposition to another is not known, an implication may still hold very well. To be valid, an inference requires that there should be an implication between propositions. "The being of an implication does not depend upon the occurrence of the psychological process of inferring".

Probable Inference

Probable inference arises out of partial or incomplete evidence. A probable inference is true in most of the cases. The probability of an inference may be increased by bringing in additional evidence.

Since induction or generalisation is often based on limited number of cases, it can only give probable inference. Another form of probable inference is the presumption of fact. Presumption of fact leads us to deduce a fact which cannot be directly observed. For instance, if anybody is feeling giddiness, we may presume that he has nervous strain. But from the point of necessary implication, the inference in this case is invalid. For, here, the observable fact may be due to other causes. Therefore, our generalisation here is only a probable conclusion, because in series of possible inferences, the conclusion is true with a considerable relative frequency when the premise is true. When a theory is probable and cannot be verified, we can, in some cases, verify the propositions which are the logical consequences of the theory.

Probable inferences have the following essential characteristics:

1. A proposition is probable in relation to other propositions which can be taken as the evidence for it.
2. Probability is an objective consideration and not a subjective feeling.
3. The very meaning of probability entails relative frequencies. The theory is probable when the argument for it belongs to a class of arguments where the relative frequency (r) of the truth of the conclusion, when the premise is true, is not necessarily 1.
4. The same proposition may have different degrees of probability in accordance with the supporting evidence.
5. Evidence may have varying probability, and the evidence which has greatest probability is generally chosen.
6. Although the measure of probability is the relative frequency, the definite numerical value of probability is unknown in most of the cases.

Paradox of Inference

On the one hand, it is said that the conclusion must follow from or must be contained in the premises; and on the other hand, it is said that conclusion must be different (something new) from the premises. This is then a paradox.

However, a psychological novelty is different from a logical novelty. An inference may be quite valid even though the conclusion is quite familiar. A conclusion may not be quite familiar if the argument has a long series of inferences. Logical novelty means the logical independence of the conclusion from the premises. In a valid argument, the conclusion cannot possess logical novelty. When we say that the conclusion is contained in the premise, we mean that the conclusion is implied by the premise. The inferences are valid if

there are objective relations of implications between propositions. Inferences are generally made, but implications are discovered. We may distinguish between the conventional meaning of a proposition, and the proposition that is implied. The conventional meaning of "All men are mortal" is that the class of men is included in the class of mortals. This distinction is helpful in solving the paradox of inference. Ordinarily, the conventional meaning of the premise is present very much in the mind and that of the implied propositions may be absent. Therefore, when the latter are found to be implied by premises, a sense of novelty comes in the mind. From the point of view of the relations between conventional meanings, the meaning of the implied propositions is always contained in the meaning of the premises. After all, the relations of implications hold good not because of the empirical truth of the premises, but because of the logical relations between the premises and the conclusion.

However, inductive inference must conform to the rules of valid inference. Induction and deduction are not opposed as forms of inference. The actual contrast is not between deductive and inductive inference, but between inferences which are necessary, and inferences which are probable. This is so, because the evidence for universal propositions cannot be more than probable.¹

1. Cohen and Nagel, *op. cit.*, p. 279.

Classification, Definition and Description

Classification

Classification means grouping together of things on the basis of a particular trait, or similarity. The common similarity, which is the basis of classification, is found through mental grouping, together of things and not always through physical grouping.

Classifications may differ in their logical and scientific significance because various traits differ to a great extent with respect to their fruitfulness as principles of organised knowledge. Some traits may have higher logical value than others for the attainment of systematic knowledge or science. It is important to pick out that trait of the objects studied which can give a significant revelation of their nature. But there is no definite rule for doing so. It depends to a considerable extent, on the knowledge and experience of the person doing it. Formal logic is helpful in that it can define the objects and traits and can permit consequent systematic deductive reasoning.

Natural and Artificial Classification

The classification which is based on the nature of things is called natural classification; and other classifications are called artificial classification. The distinction is based on the purpose of classification. The purpose of natural classification is to know the nature of things but the purpose of artificial classification is to serve some practical human needs. The objective of artificial classification is practical.

All classifications can also be said to be artificial, in the sense that the traits are selected on the basis of which the classification is made. Artificial classification is sometimes natural because the attributes belong to the objects classified. Natural classification is also sometimes artificial, because the former is man-made and

serves the purpose of some practical, human needs. Artificial classification may not be significant in the sense of providing useful clues for systematising our knowledge about the things. But the attributes of natural classification are significant in the sense that they reveal more about the nature of things. With the advancement of knowledge, it is possible to discover points of similarity behind apparent differences, and points of difference behind apparent similarities. However, with the advancement of scientific knowledge, it becomes possible to know more about the nature of things; and a new method of classification may be substituted for the old.

Division of Classification

Classification does not consist in the grouping of things alone, but grouping of class as well. Individual things, having the same characteristics are called the "species," and different things having some common features are grouped into a "family". The families are combined into higher groups called "orders," and orders into "classes." A 'division' is nothing but the exhibition of various species in the same genus. Division means the breaking-up of classes into sub-classes. When division is considered with respect to the individual members, the process is called classification.

Rules for Division (or classification)

- (i) The constituent species of the genus must exclude one another.
- (ii) Every species in the genus must be considered.
- (iii) A division must proceed at each stage upon a single principle e.g. in the case of professors, the subject-matters they profess.

However, these rules are only ideal, and as such, inadequate for the development of science. With the growth of knowledge, something new in the subject-matter may be explored; and classification or division may be made more exhaustive.

In Aristotle's dichotomous division, one cannot be sure that all the sub-classes have members. "The practical difficulty of finding significant principles of division still remains." Be that as it may, at the early stage, all sciences remain classificatory; and grouping of objects may be taken up with a view to having mastery over the subject-matter.

Nature of Classification

- (i) Classification is mental grouping of phenomena or facts.
- (ii) Things are classified according to their resemblances or differences.
- (iii) Classification is done for some definite purpose.

Purpose of Classification:

1. The general or scientific purpose of classification is to extend the area of knowledge.
2. Classification may also be made for some special advantage or purpose, e.g. a librarian classifies books for facilitating the finding out of books.

Classification as a Method of Science

1. Classification in science is done for extending the horizon of knowledge.
2. Classification in science has become more and more objective.
3. In science, for classification, more attention is paid to the nature of the thing.
4. Classification is a means to find out an order in Nature.
5. Classification is the recognition of unity in diversity.
6. It is the first method in science.
7. It finds out objective relations among things.

Steps in Scientific Classification

- (i) Firstly, on the basis of most important and essential points of similarities, the things are grouped and classified.
- (ii) The things are then classified on the basis of similarities and differences.
- (iii) The smaller group is classified into higher groups, the higher groups are classified into still higher groups and so on. Thus, scientific classification is graduated upward.

Limits to Scientific Classification

- (i) Classification proceeds from less general to more general.
- (ii) Things which cannot be defined, cannot also be classified.
- (iii) Marginal cases (cases having certain features of one class and certain other of a different class) cannot be scientifically classified.
- (iv) It is only rudimentary. It cannot say why the classes are such as they are.

Uses of Classification

- (i) Classification is similar to explanation. It gives a better understanding of the facts of Nature, and it increases the horizon of knowledge.

- (ii) We can remember similarities or differences more easily. Thus classification is an aid to memory.

Classification and Description

They are closely connected. Description may be easy or difficult. In difficult cases, the qualities, processes etc. may be hard to describe. Quantitative consideration may arise in both classification and description—and the matter becomes difficult to handle. In that case, a science develops nomenclature and terminology. With these, description and classification become easier. In an ordinary case, a thing is first classified and then described.

Classification and Definition

Classification means the grouping of facts or objects into classes according to the most important point of resemblances. In definition we determine the essential quality of things. Thus, classification is based on definition. Individuals can be classified into groups when their essential qualities are known. But in artificial classification, it is not required. In artificial classification, definition is not important.

Definition

According to Aristotle, "a definition is a phrase signifying a thing's essence." By 'essence' he means fundamental attributes of a thing. A definition is the precise statement of the meaning of a word. A science works through languages which should be free from vagueness and ambiguity. Language is a system of symbols. The symbol stands for something. The symbols may be words or nonverbal signs. The purpose of definition is to make clear and precise what a symbol stands for or refers to.

Nominal and Real Definitions : A nominal definition is a resolution or agreement with respect to the use of a verbal symbol or word. Nominal definition is only a linguistic decision; it has got nothing to do with the nature of things. It is neither true nor false, and as such, it cannot be a proposition or premise.

Nominal definition helps in scientific enquiry by:

- (i) economising time, space and energy and by making symbols clear, precise and simple.
- (ii) making the familiar terms into somewhat unfamiliar and technical, because by doing so, irrelevant, emotional and accidental associations may be shed out and the process of deduction may be made rigorous.

A real definition expresses the precise nature of a thing which

is being defined. Such a definition describes the essential nature of a thing. The real definition of 'horse' should give the precise nature of horse. Essential nature consists of those features without which the word defined would not refer to it. A real definition may be a genuine proposition.

Definition of a thing incorporates two aspects of the thing—its genus and its differentiating features. Thus, the genus of a triangle is a figure, and the differentiating feature of a triangle is that it has three sides.

Rules for Definitions

1. A definition must give the essential features of the thing which is defined.
2. A definition must not be circular. It must not contain the subject which is to be defined.
3. A definition must be in the positive term (where it can be).
4. A definition must not be expressed in vague, ambiguous and figurative language.

Psychological Motive and Logical Purpose of Definition

Definitions satisfy the psychological desire to learn new things, to find convenient and short expressions for long ones, and to make the meaning of a word precise, clear and definite. The meaning of a word may be grasped with the help of synonyms, although synonyms do not have precisely the same meaning. But the common intention can convey the meaning of the word in a more or less precise manner.

Logically, definitions are helpful for finding the structure of the concept in order to make it definite for the purpose of systematic exploration of the subject-matter. According to Aristotle, "the basic premises of demonstrations are definitions". In the mathematical techniques, all real definitions are implicit. In logical techniques, real definitions appear as axioms. Axioms are prior to all theorems, but are not prior to the development of knowledge.

The distinction between nominal and real definitions is not very clear-cut. Conflicting attitudes towards religion, law and property could be minimised if precisely defined equivalents are found. The emotional associations of words may be reduced, and social science may be made more precise, if definitions are made clear and precise. A real definition involves two sets of meaning which are equivalent, if the definition is true.

Deductive and Inductive Definitions: In deductive definition, we state the meaning of which is fixed. But in inductive definition, we try

to determine the connection of a term by examining facts. Inductive definition precedes deductive definition. Where examination of facts is not necessary, e.g. as in Mathematics, we use deductive definition. When, on examination, we come to know that human beings possess the attributes "animality" and "rationality", then we are employing inductive definition. Once the meaning is had, we employ the deductive definition that "Man is a rational Animal."

Substantial and Genetic Definition : A substantial definition is the description of the defined thing or term. It gives the substance or the essence of the term. A substantial definition is the same as the real definition, because both point out the essential characteristics of the thing. If we define a triangle as a plane figure bounded by three straight lines, then it is a substantial definition.

Genetic definition does not point out the essential characteristics of the thing, but it points out the way in which the connotation of a thing can be determined. For instance, it does not define a triangle, but simply states how it is formed. This definition is helpful for the formation of definitions. A genetic definition indicates the mode of the origin, for the formation of the thing, and thus, helps us in understanding the essential nature of the thing.

Material Conditions of Definitions : Material conditions are the procedures necessary for knowing the essential qualities of a term. They are the following:

1. The instance of the thing should be collected, then differing characteristics are excluded and common essential characteristics are to be taken. This is the positive method.

2. In order to know the essential qualities, we must know the opposite notions of things. For instance, in order to know the essential qualities of a solid, we may say that it has a fixed form. This is positive notion. We find that liquid or gases have no solid form. Hence, our previous finding is correct. This comparison with other objects is an opposite notion here. This method is the negative method.

However, positive instances are numerous and there are also marginal instances. Therefore, it is practically very difficult to apply these methods.

3. Definition by type is employed by certain logicians to eradicate the above difficulties. Type means a member of a class possessing the characteristic of that class in a marked degree. For example, a Chinese may be said to be a type of the Mongolian race. Thus, instead of describing the essential features of the Mongolian race, we simply refer to the Chinese. However, by this definition, the real difficulty cannot be avoided, because in order to know the type, we must have the knowledge of the essential qualities.

Dynamic Nature of Definition

A definition is an essential aspect of knowledge. In any science, a reference to the definition of terms will point out the progress attained by the science. Definitions represent the basic feature of scientific knowledge. At a particular point of time, the definition of a term may be adequate, but as new facts are developed and knowledge increases, the previous definition may be found to be inadequate or incomplete. All definitions in sciences may undergo changes. Thus, a definition is a dynamic concept. For example, economics is no longer defined as the science of wealth or money, but is defined as the science of product behaviour.

Theory of Predicables

This theory provides the logical basis of definition. It was originally put forward by Aristotle. It finds out the way in which the predicate is related to the subject in a proposition. The predicate is that which asserts something about the subject. Predicables are terms used for indicating the ways in which the predicate is related to the subject.

According to Aristotle, in certain cases the predicables are convertible with the subject (i.e. may be substituted for the subject). But in some other cases, the predicables are not convertible with the subject. In the former case, the predicate is the definition or the *property* of the subject. In the latter case, there are two possibilities: (i) the predicate may be contained in the definition of the subject, but is not completely convertible with the subject. In this case, it may be the *genus* or the *differentia* (ii) It may not be contained in the definition of the subject or it is not convertible with the subject. In that case, it may be an *accident*. Thus the predicate is related to the subject in one of the five following ways:

- (a) Definition
- (b) Property
- (c) Genus
- (d) Differentia
- (e) Accidents

(a) *Definition* : It states the essential characteristics of the thing. It is a thing's full connotation or essence.

(b) *Property* : It is an attribute of the thing. It is derived from the essence. A property does not represent definition, but is associated with the thing which is being defined. For instance, animality is a property of human beings, but it is not the definition of human beings.

(c) *Genus and Species*: A genus is a class of things to which a

particular subject belongs. It is an essential part of a definition. "Animality" represents a genus to the category of living beings.

When a smaller class is included in the larger class, the small class is called a *species*. For instance, animal is genus and man as a subject class of genus is a species. A term may be genus in one context but species in another context.

(d) *Differentia*: It is a distinguishing feature of a thing by which a thing can be differentiated from another thing of the same category. "Rationality" is a differentia in human beings, because it is rationality which distinguishes man from other animals. A complete definition must state both genus and differentia.

(e) *Accidents*: It is a quality which is connected with a thing by chance. It is not a part of the connotation of the thing. The colour of a man is an accident, because it is neither the connotation, nor can be inferred from the definition.

Thus, a definition is a precise, clear, and explicit statement about the essential characteristics of a thing. In a definition, the defining expression must contain more than one word. A perfect definition must state differentia and genus.

Description

Description is the statement of essential characteristics of a thing. With help of description, we can know the characteristics of a thing. Thus, grouping can be easily done. For scientific classification, it is essential to have a detailed knowledge of the things which are to be classified. Since the characteristics are not perfectly remembered for a long time, it is necessary to record description. When things are classified into various groups, the correct description of the nature of each class is required. The description is required to specify the common characteristics and particularly, the more important characteristics. The important quantitative differences of common characteristics between the things of the same class are necessary to record in description. The degree of common characteristics may vary from one thing to another even in the same category. These differences in degrees have to be described and known by a scientist. Since description requires the use of language, a science must develop its own nomenclature and terminologies. Thus, we find that description is relevant to classification.

Description and Definition

Description is a statement of property or characteristics of any term. Definition is the statement of connotation. 'Property' or 'attribute' is not the same as connotation. Property, however, follows from definition. Description includes every aspect, and as such, it is broader than definition. Definition is only a very precise statement

of the most essential attributes. Description is more general but definition is more particular. Description is not very precise; it is popular but not as scientific as definition. Definition is about a term; but description is about objects or events.

Limitations of Definitions

- (i) The highest genus or broadest category cannot be defined.
- (ii) The terms, representing unique features, that cannot be connected with other things, cannot be defined. For instance, "sensation" cannot be precisely defined.
- (iii) The terms having no connotation cannot be defined.
- (iv) Terms representing classes of events or objects can only be defined. Thus, individual objects cannot be defined.

Explanation

Meaning

This is essentially the same kind of reasoning as interpretation.¹ Explanation is the mental process used for clarification of understanding. Explanation is used when there is complexity or perplexity about something. It is the mind which determines perplexity and clarity. The necessity of explanation and the explanation itself are entirely the feelings of mind. Perplexity generates dissatisfaction and uneasiness in mind, while the clarity of understanding brings a sense of satisfaction and ease of mind. The urge to explain away things and to have clear understanding about matters, is a universal human urge which requires to be fulfilled. Curiosity leads to knowing and to know clearly, explanation becomes a necessity.

Understanding is the basis for explanation. But understanding can only be made through the process of relations between facts. If one is unable to find out the involved relations, one cannot understand the things. Understanding is to be made through mind by properly relating together the involved facts. A fact is anything that there is, or can be conceived of. Perhaps more important than finding out facts is the finding out of relations between facts, because facts themselves are not so crucial for explanation as relations are. Once the relations are discovered and understood properly, the facts can be shown to be an integral part of the system or order. A system implies an arrangement in which things are related together in a particular cohesive pattern. Judged in this way, every science is nothing but a system. Since explanation discovers the position of the thing explained in the system, it becomes a *sine qua non* for any science. As a system of knowledge, science seeks to discover an actual order in Nature which consists of various objects. Explanation, therefore, would correspond and help the process of systematisation of knowledge taken up by science for facilitating the discovery of order in Nature. Knowing, as we have pointed out, entails explanation; and once we come to this stage, we have science. However,

1. Goode and Hatt, *Methods In Social Research*, p. 355.

explanation is implicit in the universe of formal relations as well as in the universe of matters of fact. Logic is so fundamental to explanation that the Greek philosophers named different material sciences in terms of logic, e.g., geology.

Description and Explanation in Science

An opinion is generally expressed that science is mainly concerned with description and not with explanation. That is, a science should describe whatever is observed and it should not bring in the personal insight by way of explanation. This implies that the business of science is to investigate as to how a phenomenon happens and not as to why it happens.

There are, of course, arguments for this conservative attitude towards science. Explanation, more often than not, involves personal prejudice, likes and dislikes. There is a tendency on the part of people to explain natural phenomena in the same fashion as they explain their own personal actions and problems. Thus, explanation often becomes anthropomorphic, and not impersonal. This is one of the reasons why explanation is not considered to be the main function of a science. Ordinarily, explanation is looked upon as an action to some purpose or motive. As soon as the motive or purpose is found out, the action is explained finally and nothing further is called for. Therefore, the finding out of the purpose or motive becomes the main task of enquiry for explaining the natural phenomena. Thus, drought, diseases etc. are explained as the punishment imposed by God on people for their wrong actions. The purpose, of course, is realised at the final stage of an arrangement or process. Unless the final outcome of the entire activity or process is known, the purpose behind it cannot be ascertained. The purpose is, therefore, the final cause. Explanation in terms of the purpose is called the explanation with reference to final cause. But proper explanations can unfold various aspects of the phenomenon studied, e.g., where the phenomenon happens, why it happens who is responsible for it, when it happens and how it happens, and so on. But it should be noted here that while spelling out the different aspects of a phenomenon, explanation has to be in sympathy with description.

Modern science always does not explain away things with reference to final causes, except under certain compelling situations. But it is not justifiable to say that a science only describes and does not explain. A science starts with the particular but it is not concerned essentially with the particular, but with the general. Predictability is one of the most important functions of a science. A scientific law cannot be said to be descriptive of the observed cases alone. It does not restrict itself to the observed cases, but it is extended to the unobserved cases also which are necessarily infinite and indefinite. Braithwaite has rightly pointed out that, "the predictive function of a

scientific law would be ignored if the function of the law were taken as being purely descriptive."²

Unless the science offers explanation, we would not be in a position to appreciate even commonly known facts. There is no clear-cut distinction of apple-pie order between what is observed—the thing that there is or that can be conceived of, and what is contributed by science in its own way by way of interpretation, explanation and systematisation. Explanation and interpretation are involved even in what appears to be the direct and immediate knowledge of an object through sense impressions. It is, therefore, not right to observe that the main task of a scientist is to describe the observed facts as they are, without any attempt to explain them. The proper meaning of a fact becomes clear with the help of proper explanations. Without explanation, facts remain merely dumb, barren and useless pieces of scattered information. "We can claim indeed that we 'see' the fixed stars, the earth eclipsing the moon, bees gathering nectar for honey, or a storm approaching. But we shall be less ready to maintain that we simply and literally see these things, unaided by any theory, if we remember how comparatively recent in human history are these explanations of what it is we see...the objects of our seeing, hearing, and so on, acquire meaning for us only when we link up what is directly given in experience with what is not. This brilliant white spot of light against the deep-blue background—it has an incommunicable quality; but it also means a star many light-years away."³

Types of Explanation

Explanation can be categorised into the following types:

(1) *Evolutionary Explanation* : This is a type of explanation in which a particular thing is explained by finding its place and position in the whole process of evolution. If a skeleton of an animal, for instance, is found under the earth, the anthropologist will try to understand the nature of the skeleton. He will provide explanations to support his view that the skeleton belongs to a particular type of animal. But he can tell this by classifying the animals and their skeletons. However, the skeleton may be similar to that of another type of animal, but the skeleton may not be so strikingly similar as to be certainly included in that type of animal. Under these circumstances, what is done is to trace its place as a link in the concerned process of evolution. This particular type of study of the process of evolution may be considerably helped by the explorations in the field already made by anthropology. By investigation, it may be found that exactly such a structure of the skeleton fits in with the

2. R.B. Braithwaite, *Scientific Explanation*, p. 348.

3. Cohen and Nagel, *An Introduction to Logic and Scientific Method* (abridged edn.), p. 10.

skeleton of the dinosaurs at a particular stage (say 500 years back) of evolution of the skeleton of dinosaurs, which had already been definitely traced. Thus, the obvious explanation would be that the skeleton which has been found is the skeleton of dinosaurs which existed some 500 years back. The basis of this explanation is the link provided by a certain series of evolutionary process.

(2) *Classification*: Classification itself is a type of explanation. Classification implies the finding out of relations between the things classified. The finding out of connecting relations between facts is known as explanation. Thus, explanation is obvious in classification, although this type of explanation is inadequate. If we come across a snakelike thing, we may not be able to explain it immediately unless we know its name and nature. However, by noticing its feature, we can classify it as a reptile. This classification then, provides at least an elementary explanation. Here, the basis of explanation is the class to which the object belongs. Similarly, a class can itself be a sub-class of a large class.

(3) *Concatenation*: In this type of explanation, we trace out the intermediate steps by which the two concerned facts become related. The meaning of concatenation is linking together. For instance, it is found that water becomes cool very quickly in an earthen pot. Here, the explanation would take the form of tracing the intermediate factor of continuous evaporation of water which oozes through the pores of unglazed pitcher, that makes the water cool.

(4) *Laws*: It is a general practice that a thing which is to be explained is first related to the established law or laws that are relevant. Since by definition, laws are the statements of uniformities, it is possible to find in laws a certain uniformity, system, order or regularity. The thing is then explained by discovering its position in the system or order of relations as suggested by the law or laws. For instance, inflation is explained by discovering the place of products in the system or order of relationship between demand, supply and price as suggested by the laws of demand and supply. Ultimately, it may be explained that inflation is due to either increase in demand, supply being fixed (or demand growing at a less than proportionate rate), or increase in demand, supply being lower or, demand remaining fixed, supply being very very low.

(5) *Induction*: Induction is also a type of explanation. In induction, we pass on from particular to general, from observed to unobserved. What we find true of observed, we generalise for unobserved, the nature of things remaining the same. This generalisation regarding the unknown passage is itself an explanation. Generalisation means the indication of uniformity, order or system where objects are related together.

(6) *Teleological Explanation*: Where explanation of a phenomenon is provided with reference to the final cause or purpose, we

have teleological explanation. This type of explanation was mostly used by Aristotle in his analysis of politics. Where human actions are involved, such an explanation is not used in physical sciences, it nevertheless has relevance in the analysis of some biological phenomena.

(7) *Theory*: Ordinary laws are explained by the help of more comprehensive laws or by theorising (construction of theories). In this type of explanation, one has to discover the place of law in a theoretical system or order. The process of discovery of laws from facts, and theory from laws, entails explanation. Facts can be explained by other facts or laws (which in themselves are facts). Ordinary laws can be explained by demonstrating that they can be deduced from more comprehensive laws of a theoretical system. This process of explanation or analysis is called the process of subsumption or bringing under. The facts are brought under laws and ordinary laws are brought under more comprehensive laws. This is the way in which a science is constantly engaged in the study of Nature. However, at certain stages of scientific enquiry, some super-laws may be encountered which cannot be explained satisfactorily, since they cannot be shown to be deducible from some other laws. Thus, science faces problems and doubts are raised about the capability of science as an omnipotent system of explanation. When more knowledge is accumulated, such unexplained laws may be explained. However, "there is no ultimate end to the hierarchy of scientific explanation, and thus no completely final explanation."⁴ After all, a scientist's last explanation is not his final explanation.

Analogy, Sampling and Induction

Reasoning from Analogy

Analogy means similarity or resemblance. If we say that A and B resemble in intelligence, memory and studies, and A has stood first in the class, therefore, B would also stand first in the class; we are, in fact, arguing from analogy.

Some have argued that argument from analogy is a form of induction. Both analogy and induction are based on observation and both pass judgement from observed to unobserved. But in analogy there cannot be any effective generalisation. We cannot say surely whether B would stand first in the class or not. This is because we do not have knowledge that there is any positive correlation between intelligence, memory, studies and standing first in the class. But still, it must be pointed out, these qualities have something to do with standing first, or at least they are relevant.

In induction, generalisation is possible. The factor of enumeration and the factor of analogy together give the basis for good induction. As a matter of fact, even in induction by simple enumeration, analogy is present. Sometimes, analogy is presupposed in generalisation when we say that what has been observed to be true in some cases will also be true of all other cases having same conditions, type and circumstances.

But analogy is sometimes too weak to lead to any valid induction. Let us take an example of an argument from an analogy.

A and B resemble in having a cycle, a watch and a camera. A has stood first in the class. Therefore, B will also stand first in the class.

This argument is absurd. These things have nothing to do with standing first in the class. But our earlier example is not absurd. This second example has no force, while the first has.

The proposition that "All men are mortal" can be expressed in two types of analogy: All things which have the signifying analogy

"being human" also have the signified analogy "being mortal". In establishing a universal proposition, a signifying analogy is constantly conjoined with a signified analogy.¹ But these two analogies never exhaust the total positive analogy, nor even the known analogy. Universal propositions do not cover the total positive analogy. The part of the positive analogy not included in either the signified or the signifying analogy, is considered irrelevant. However, it is the objective of science to discover in observed things those parts of total positive analogies which are related invariably.

However, if we remember the first example given in this chapter, it can be easily understood that analogical reasoning is only a case of probable inference; and this depends on fair sampling.

Analogy and Scientific Induction

Analogy, according to Mill, is a kind of induction. In induction, there is a passage from known to unknown. This feature is present in analogy. Thus, analogy is a sub-division of induction. But since in analogy there is an imperfect similarity, analogy is regarded as a weak form of inductive argument. A comparison can be made between analogical reasoning and scientific induction.

1. In analogy, we proceed from particular to particular, but in scientific induction, we proceed from particular to general.

2. Scientific induction is based on the knowledge of causal connection (cause-effect relation), but in analogy, we do not get such knowledge.

3. The conclusion in scientific induction is certain, but the conclusion in analogy is only probable. This is so because, in analogy there is imperfect similarity and hence, there is an element of doubt.

4. Analogy is the first step towards scientific induction. Analogy is a form of hypothesis. When it is proved, a scientific induction may be possible.

Strength of Analogical Reasoning (Factors Determining the Force of Analogy)

Analogy is based on imperfect resemblance. The conclusion in analogy, therefore, is only probable. However, the degree of this probability may vary from zero to certainty. The force of the analogical argument will depend on the following factors:

1. The greater the importance and the number of known resemblances, the greater is the force of the analogical argument. The resemblances should not be counted quantitatively alone; the importance of the resemblance is also to be taken into account. The more relevant the points, the more important they are.

1. *ibid.*, p. 287.

2. The greater the importance and the number of known differences, the smaller is the force of the analogical reasoning. This is obvious because the basis of the argument is the resemblance between the things. If the things differ in many respects, then there would be less resemblances and analogy.

3. The greater the extent of knowledge about the things, the greater is the force of analogical argument. When the knowledge about the things is very comprehensive, it is possible to notice the important points of resemblances and differences.

4. The greater the number of unknown points as compared with the number of known points, the smaller is the force of analogical arguments. When the number of unknown points is greater, we cannot be sure in ascertaining the analogy between the things. Thus, our conclusion would be very uncertain and rough.

5. The force of an analogical argument depends upon the importance of the points of resemblances. Welton says that the force of an analogical argument, depends on the character of identity and not on the amount of similarity. "We must weigh the points of resemblances rather than count them".

6. The force of an analogical argument is expressed as:

$$\frac{\text{Resemblances}}{\text{Difference} + \text{Unknown Points}}$$

The numerator stands for the force of an analogical argument, the denominator stands for the weakness of analogical argument. So, if the value of the numerator is greater than that of denominator, the analogical argument becomes strong.

However, the force of an analogical argument cannot be calculated precisely through a mathematical ratio. In the above expression, the importance of resemblances is not taken into account. But this is more important. The importance, however, cannot be mathematically determined. Another difficulty is represented by unknown points. If the points are unknown, how can we know their numbers?

Misuse of Analogy (True and False Analogy)

A true or good analogy means an argument in which the conclusion is drawn from the presence of essential resemblances between two things. The resemblances should be important and greater in number as compared to differences. The comparison should be comprehensive between two things.

A false or bad analogy means an argument in which the conclusion is drawn from superficial points of resemblances. In a false analogy, the argument is fallacious, careless and hasty. Due to the following reasons an analogy becomes false:

1. Superficial resemblances are taken into account between two things.
2. The important points of differences between the things may be overlooked.
3. Lack of comprehensive knowledge about the things.
4. Use of very remote simile and metaphor. These stand in the way of making important differences.
5. Confusion between the essential and non-essential points.

False analogy leads to the following fallacies:

(i) Fallacies arising out of confusion between the essential and non-essential points (i.e. overlooking important points of differences), e.g.,

"Plants, like men, have birth, growth and decay and death. Men possess intelligence; therefore, plants also possess intelligence."

This is a fallacy because the important differences between men and plants are overlooked. There is no essential connection between the points of the resemblance and the property which is inferred.

(ii) Fallacies arising out of improper use of metaphysical language, e.g., "The capital is the heart of the country, so if the capital of a country becomes very large, it is bad for the country, as the enlargement of heart is bad for the body".

(iii) Fallacies arising out of insignificant or unimportant resemblance between two things, e.g., "He will stand first in the examination, because his friend has stood first in the examination."

Here, the similarity is very superficial and unimportant.

Analogy and Fair Sampling

The principle of analogy is significantly connected with the principle of fair sampling. Observed instances are considered to be fair samples, because the observed instances are analogous to unobserved instances. Things are analogous in some relevant way and different in some other ways. But whether things are analogous or different would depend upon the purpose for which an enquiry is undertaken. Human beings are different in various ways; and similar also in various ways. But when the purpose of enquiry is to find out mortality, an analogy is found among them in this respect. Whether a generalisation can be relied on or not depends on whether the observed cases are of the type which the generalisation is sought for or not. For being samples, the observed cases must be analogous to the cases which are being considered for generalisation. The observed cases must be relevant to the phenomenon being studied.

A reliable generalisation, therefore, presupposes knowledge about the phenomenon, the type of case and the relevance of cases with the phenomenon. For a good generalisation, the number of sampling need not always be overwhelming. Mill remarks that often a very large number of verifying instances is insufficient to establish a generalisation firmly; while a few such instances are sufficient for generalisation.

A scientific induction is based on a type of study of the instances by which we can know whether observed cases can be considered fair samples or not.

Analogy sometimes becomes important and relevant for the reliability of the scientific generalisation. If the instances of the present phenomenon which is being studied become analogous to the instances of some other phenomenon which has already been studied and about which generalisation has been arrived at, then the generalisation of the earlier case can be used profitably to study the present case in hand. According to Cohen and Nagel, since electricity in motion presents certain striking analogies to the behaviour of liquids like water, the entire theory of hydrodynamics which deals with liquids may be extended to the phenomenon of electricity.

Generalisations on similar problems even in different fields may support each other. Hence, the reliability of a generalisation does not merely depend on the number of its verifying instances. Repetition of instances is valuable only if the subject is not homogeneous.

If the generalisation under enquiry can be connected with others, the ability to conduct fair sampling can be increased to a great extent; because in that case the verifying instances for a universal proposition can be gathered rapidly, since the generalisations would support one another. That is the reason why the deductive elaboration of hypotheses forms an essential part of the scientific method.

Role of Fair Samples in Induction

Inductive generalisations cannot always be conclusive. But scientific generalisation should have the highest degree of probability. A scientist is not interested in multiplying the verifying instances for generalisation. In this connection, the observation made by Mill seems to be relevant. "Why is a single instance, in some cases, sufficient for a complete induction, while in others, myriads of concurring instances without a single exception known or presumed, go such a very little way towards establishing a universal proposition? Whoever can answer this question knows more of the philosophy of logic than the wisest of ancients, and has solved the problem of induction".

The problem is to find fair samples which are instances of that kind. Fair samples should be representative instances which can

be used as evidence for the generalisation for which such instances are being collected. Ordinarily, the larger the number of instances, the greater is the probability of valid generalisation. In some cases, a single instance, observed under suitable conditions, may constitute a fair sample.² If an instance is highly representative, it may suffice and there is no need to adding more instances to it. A large number of instances which are equal with one another in representation of that type, will serve the same purpose as anyone of them. A large number of instances may not always be fair samples, if they are not representative in character: and therefore, may not serve the purpose.

In fair sampling, the observed instances should cover as wide and as varied a range as possible within the type with which generalisation is concerned. A good sampling is based on the Law of Statistical Regularity and the Law of Large Numbers. Random selection of sample is the best representative of the population. There should be no element of human bias or prejudice in selecting samples. The Law of Inertia of Large Numbers indicates that large aggregates are more stable than small ones.

10

Causes

The Law of Causation

The law of causation states that every event has a cause. "Every phenomenon which has a beginning must have a cause". Nothing can come out of nothing. Nothing is the cause of an effect which is absent when the effect takes place. Similarly, nothing is the cause of an effect which is present when the effect does not take place.

The law of causation is considered as the formal ground of every induction. The objective of empirical science is to discover the laws which can express relations between the phenomena of Nature, that hold good universally. The method by which the universal propositions are arrived at for expressing laws is called induction. Induction is a process of generalisation. The formal truth of the inductive generalisation is guaranteed by the law of causation. It says that phenomena are related as cause and effect, and this relation expresses a uniformity of succession. Therefore, we can say that what has been observed to be the case so far, will also be the case in future. In other words, the causal connection holds good uniformly. The law of causation is like an axiom. We can deduce from the law of causation, certain principles, such as the *canons of elimination* which form the basis of enquiry into the cause of a phenomenon. The canon of elimination is a test to find out the cause of a phenomenon. These canons can decide the formal truth of induction, and since these canons themselves are deduced from the law of causation, we generally say that this law is the formal ground of induction.

Law of Causation and Uniformity of Nature

According to Prof. Bain, the law of causation is a special form of the law of uniformity of Nature (uniformity of succession). By uniformity of Nature is meant that, in general, there is some definite order in Nature. The law of causation not only implies that every phenomenon has a cause, but also implies that the same cause gives always rise to the same effect. The law of causation speaks about

a special form of order—the order of the cause-effect relationship. The cause is the invariable antecedent of effect, and the effect is the invariable consequent of the cause. However, certain logicians argue that causation and uniformity of Nature are two separate and distinct laws. When we say that the same cause always produces the same effect, we are, in fact, taking into account the law of uniformity of Nature. When from cause-effect relationship of one phenomenon, we make generalisations for other phenomena, we are believing in the uniformity of Nature. The law of causation is alone the basis of scientific induction where generalisation depends on the discovery and proof of a causal connection. But the law of uniformity of Nature is the formal ground of both scientific and unscientific types of induction. These two laws together, however, can become the adequate ground of induction.

Definition and Characteristics of Cause

Cause is the sum total of positive and negative conditions. It is the entire aggregate of conditions or circumstances requisite to the effect. Qualitatively a cause is the immediate, unconditional and invariable antecedent of the effect, and quantitatively, it is equal to the effect.

Qualitatively,

- (i) the cause is relative to a given phenomenon which is called the effect.
- (ii) Causation implies that there is change in the existing state of things (an event in time).
- (iii) the cause is an antecedent to the effect—and the antecedent is invariable.
- (iv) the cause is the unconditional antecedent (requiring no further condition).
- (v) the cause is the immediate antecedent (immediacy follows from unconditionality. The term "immediate" should not be taken too strictly here).

Quantitatively,

- (i) the cause is equal to the effect (the matter and energy in the cause are equal to the matter and energy in the effect)

Conjunction (Composition) of Causes

Generally speaking, every cause has a distinct effect, and separate causes produce separate effects. However, in actual practice, several causes act together to produce not separate effect, but a combined

effect. When several causes produce a joint effect, we call it *conjunction of causes*, and the joint effect is called the *intermixture of effects*. The doctrine of conjunction of causes should not be confused with that of plurality of causes. In conjunction of causes, several causes act jointly and produce a joint effect; but in plurality of causes, several causes, each acting separately and independently, can produce the effect, on different occasions, e.g., inflation may be produced by either excess demand, or excess cost of production, or low supply, or excess money circulation. However, the inter-mixture effects may be either homogeneous or heteropathic. In homogeneous intermixture, the joint effect is of the same kind as the separate effects; but in heteropathic intermixture, the joint effect is different from the separate effect.

Cause and Condition :

Condition means the necessary factor of a cause. Conditions may be of two types : positive and negative. If the effect is to happen at all, the positive conditions must be present, and the negative conditions must be absent. According to Carveth Read, "a positive condition is one that cannot be omitted without frustrating the effect; a negative is one that cannot be introduced without frustrating the effect." According to him, a negative condition means the preventing circumstance itself; but according to Mill, the negative condition means the absence of preventing circumstance. Thus, their views on negative condition are opposite to each other. However, Carveth Read's idea of negative condition does not seem to be correct. Why should the negative condition, which must be absent, for the effect to take place, be regarded as a necessary factor of the cause ?

In popular view, the cause is nothing but one of the conditions. This condition may be the most significant one, first or the last one, or even the negative one. Thus, in popular view, the selection of the condition as the cause is somewhat arbitrary. According to the scientific view, the cause is the sum total of the positive and negative conditions. While the cause constitutes the whole, the condition is merely a part of it. But the difficulty is this that all the negative conditions cannot be exhaustively enumerated. In fact, the absence of preventing circumstances may be many and infinite. Even in the enumeration of positive conditions, we do not take into account all the factors. What we actually consider is the proximate and immediate antecedent; the remote antecedent or condition is generally avoided.

Aristotle's View of Cause

1. Aristotle observes that every cause is a mixture of four factors; and each of these factors is by itself a cause. The four factors or causes are as follows :

The formal cause is related to the change in the form or shape of thing. When an effect is produced, there happens some change in the form of a thing.

2. The material cause is related to the matter or substance of which a thing is made. The nature and extent of the effect depend on the nature of the material. The material on which the effect takes place is to be considered as an element in the causation of changes.

3. The efficient cause of thing is related to the skill, labour etc. expended to produce the thing. Thus, the skill or efficiency applied to the material to produce a painting is the efficient cause of painting.

4. The final cause of a thing is related to the purpose or objective for which the thing is ultimately done.

Since formal and material causes are related to the constituent elements of a thing itself, they are called intrinsic causes; but efficient and final causes are extrinsic, because they are related only to the external or outside element of a thing.

Popular View of Cause

In popular view, the cause is one of the conditions. There is an element of arbitrariness in the selection of the condition constituting the cause. In popular view, the most striking single condition is selected as the cause. This is arbitrary and unanalytical. According to this view, the antecedent of an effect is regarded as a cause. Although this view is more or less correct, it is not, however, always scientifically true. In the popular view, the cause-effect is explained, more often than not, in terms of personal choice and subjective considerations. A cause is ordinarily understood as the one which produces the effect. This view of cause is anthropomorphical, because it sometimes associates human attributes to non-human things. There is a tendency on the part of human beings to understand the phenomena of Nature in the same way as they understand their own actions. The cause is generally regarded as an agent which acts on something to produce effect. Thus, the popular view of cause is unanalytical, incomplete, arbitrary, personal and unscientific.

Scientific View of Cause

According to the scientific view, the cause is the variable antecedent of effect. The cause is regarded as the antecedent and the effect as the consequent. The cause is the initially responsible condition and the effect is the final result. The cause-effect relationship represents, according to Mill, uniformity of succession. Every antecedent is not regarded as a cause. Only the invariable, unconditional and immediate antecedent is looked upon as the cause. This notion

of cause is conspicuous by its absence in the popular view of cause. In Mill's view, the same cause always gives rise to the same effect.

In scientific explanation, the cause must be regarded, as Bain observes, as the entire aggregate of conditions and circumstances requisite to the effect. The conditions, suppressed by the popular view, are all brought to the surface for a complete statement of cause.

According to Mill, cause is the sum total of conditions, positive and negative taken together. The cause is that group of antecedents which is enough to produce the effect without the presence of any other antecedent. A condition means any necessary factor of a cause. A positive condition is one that cannot be omitted without frustrating the effect; and a negative condition is the absence of a preventing circumstance. A condition is a part of the cause. The sum total of positive and negative conditions will be sufficient for the explanation of the cause. A necessary condition is a factor without which the phenomenon cannot take place; and a sufficient condition is a factor (or a group of factors) which does not require any further condition for the phenomenon to happen. In any explanation of cause, both the necessary and sufficient conditions are to be considered. Thus, the scientific explanation of the cause is thoroughly analytical and its objective is to find out the totality of conditions including the necessary and the sufficient ones. On this count, the popular view is utterly inadequate, because it is neither analytical, nor does it take into account all the necessary and sufficient conditions. Unlike the popular view, the scientific view does neither regard cause as the agent which produces effect, nor consider cause in terms of subjective and anthropomorphic attitude. The scientific view regards cause as a relationship between various facts having the characteristics of invariability, succession and unconditionality. In a scientific system, the explanation of the cause has got to be objective.

Modern Views on Cause

In the modern view, the traditional concept of cause is vague and unscientific. It is, in fact, very difficult to grasp the exact nature of the causal relationship. The cause-effect relationship is explained by human agents through subjective considerations. It is not wholly correct to say that every invariable antecedent is a cause, because it cannot fully establish causal relationship. Mill brought into the analysis, the idea of unconditionality; but relation between invariability and unconditionality is not very precise. In singling out a cause, it is also not physically always possible to pinpoint all the positive and negative conditions. According to Russell, we cannot find such antecedents which are always invariable.¹ If the consequent is to be properly calculated from so many varying antecedents, the latter becomes so complicated that it is very unlikely that they will again

1. B. Russell, *Analysis of Mind*, p. 96.

occur.² As the science becomes more and more progressive, we go further away from the crude law of uniformity to the wider field where there is greater differentiation of antecedents and consequent, and where the antecedents themselves are perplexing both in number and variety, but they are nonetheless relevant.³

The dichotomisation of cause and effect in clear-cut apple-pie order is not possible. The cause should not, and cannot, always be described in terms of antecedents. It is impossible to draw a line of demarcation between the ending of a cause and the beginning of an effect. As soon as the cause-events take place, the process of causation begins to appear.

However, according to the view, the causal relationship is neither universal, nor necessary. It is not proper to say that all phenomena of nature are subject to laws. The causal connection is not a necessary connection. The traditional notion of necessity attributed to the cause-effect relation is only formal, and does not and, cannot adequately deal with the universe of matters of facts. Once established, the formal or logical relation cannot be denied. But in the universe of matters of fact, as David Hume puts it, the propositions relating to matters of fact may be denied without any fear of contradiction.

In fact, there is a difference between necessity and uniformity. When we say that relation between X and Y cannot be so, we are expressing necessity; but when we say that the relationship between X and Y is not so, we are revealing uniformity. Uniformity is asserted only for the observed facts. The affirmation of uniformity about unobserved fact is doubtful and probable. Scientific induction which is based on causal connection leading to certain conclusion, loses much of its significance in the analytical framework that examines the meaning of cause. The analysis of Mill's inductive method is not able to bring out perfectly, with the help of proof, the exact cause of a phenomenon. What is done, here, is the elimination of a number of causes from all the possible causes, through the principles of elimination. These principles are derived from Mill's theory of causation; but they are not tenable. Thus Mill's stress on the certainty of scientific knowledge, is, in fact, unscientific.

Cause and Function

According to Russell, strictly speaking, there is no such thing as cause. Science does not any longer make use of the concept of cause. In fact, in progressive sciences such as gravitational astronomy, the concept, 'cause' never occurs;⁴ instead, the idea of functional relationship is used. The notion of 'function' is a mathematical concept. A particular way of describing an equation is to

2. B. Russell, *Mysticism and Logic*, p. 188.

3. Loc. cit.

4. *ibid.*, p. 180.

show a functional relationship. If $Y = f(x, a)$, it implies that the value of Y depends on the value taken by the variables ' x ' and ' a .' Here, ' Y ' is dependent variable and ' x ' and ' a ' are independent variables. The idea of functional dependence is extensively used in both physical and social sciences. In physical sciences, it is possible to determine the values of the variables with exactitude through the help of precise measuring tools. Thus, in physical sciences, the exact relationship between the factors responsible for a phenomenon can be quantitatively determined through the method of functional analysis. When we are able to do this, we can express the scientific laws in terms of causal uniformities; and the causal laws can be replaced, as Stebbing points out, by mathematical functions expressing tendencies.⁵

Russell observes that in science, when we deal with the motions of mutually gravitating bodies, we do not have anything that can be called a cause, and anything that can be called an effect; we have merely a formula. The laws can be expressed in differential equations which hold at every instant for every particle of the system, and which, given the configurations and velocities of instants, render the calculation of configuration at earlier or later instant theoretically possible.⁶ In a scientific law, Russell says, what is expressed is not a uniformity of succession or sequence, but a recurring regularity of pattern. A scientific law expresses the sameness of relationship (or better, sameness of differential equations) between the configurations at successive periods. Uniformity of sequence, (i.e. causal uniformity), according to Russell, is replaced by mathematical equation.

Laws in science do not say anything about the order in which the events take place, but they simply speak about the invariable relations existing between the observed variables.

Functional Analysis in Social Sciences

However, functional analysis holds good only in a case where there is perfect correlation between various factors. In social sciences, the correlation between various factors is not a perfect correlation; and therefore, it cannot be quantified and expressed mathematically as exactly as that in physical sciences where there is perfect correlation. The elements of human behaviour, as the social sciences study, cannot be given definite functional representation, because, human behaviour is volatile and not amenable to quantitative evaluation. Thus, in such a situation, it is difficult to find out a constant and perfect relation between various factors and elements. In social sciences, we cannot effectively isolate the purpose of detailed study, and, it is not possible to make controlled experiment. The reliability and relevance of data in social sciences, cannot be decided so easily as in physical sciences. The measurement of qualitative data in

5. L.S. Stebbing, *A Modern Introduction to Logic*, p. 351.

6. B. Russell, *Mysticism and Logic*, p. 194.

social sciences is not amenable to the ordinary process of measurement. The traditional method of measurement very often does not apply to social sciences. And without the help of the technique of measurement, the functional analysis cannot be translated into action. The sciences, therefore, take resort to statistical methods to facilitate comparison, to study the relationship between two phenomena and to interpret the complicated data for the purpose of analysis. The best result of a particular cause on a particular phenomenon can be ascertained by using statistical tools like the techniques of variance and co-variance. Statistical methods introduce the techniques of measurement required for functional analysis. They are helpful for evaluating group phenomena, and for handling numerical results in such a way that the significant relationships between properties can be studied. The comparison of a large body of data sometime helps in finding out a few correlations. But all said and done, it must be admitted that statistical methods cannot be as accurate as the experimental methods.

Plurality of Causes

Plurality of causes states that one effect is connected with many other causes. One phenomenon may be produced in so many ways. Mill observes that "many causes may produce mechanical motion; many causes may produce some kind of sensation; many causes may produce death." But if this be true, it goes against Mill's conception of the nature of cause as an invariable antecedent from which it can be said that same cause produces same effect. But a deep probe into the matter will show that Mill was not wrong. The confusion arises out of insufficient analysis of effect in so many cases where different causes are responsible. Apparently it is true that death is the same whether it is caused by burning, drowning or poisoning. But if a careful analysis is made, it can be noticed that death by drowning is not the same as death by poisoning. In each case the symptoms and signs of death will differ. The effect (death) may appear to be the same to an untrained eye, but factually it is different. In fact, different causes produce different effects. Therefore, plurality of causes for studying the same effect is not valid.

However, "the doctrine of plurality of causes is plausible only if we analyse the causes into a larger number of distinct types than we do the effect". The doctrine neglects the various differentiating factors in so many instances of the same effect.

But when a particular phenomenon or effect has the same feature when it is caused by different factors (i.e. when the effect cannot be differentiated), plurality of causes does not seem to be irrelevant. For example, price-rise may be caused by increase in demand or decrease in supply, but the phenomenon of price-rise caused by demand spurt cannot perhaps be differentiated from the phenomenon of price-rise caused by decrease in supply. There is nothing special, extra or

uncommon in the effect between these two situations. The analysis of price-rise cannot by itself reveal any distinct cause, or it may be safely presumed that price-rise has been contributed by any of the causes or several causes. Thus, in social science, the doctrine of plurality of causes does not seem to be invalid.

Mill's Methods of Experimental Enquiry

Experimental Method

It is the objective of every science to find an order among facts. The facts are explained then in a systematic way with the help of two formal assumptions:

(i) The Nature is uniform, i.e. given similar conditions, Nature will behave uniformly.

(ii) Phenomena are related in causal conditions; and to find out the causal condition is the primary aim of every science.

Mill thought that discovering causal connections is the fundamental task in induction. Since causal connections hold good invariably and unconditionally, generalisation can be done with confidence. The experimental methods formulated by Mill serve two purposes:

(i) They are methods of discovering causal connections.

(ii) They have demonstrative functions i.e. concerning proof.

Scientific laws can be established to be true. According to Mill, there is "no other uniformity in the events of nature than that which arises from the law of causation". Such uniformities can be conclusively established by these methods. In other words, an inductive argument is valid, if it conforms to the experimental methods. Five methods of experimental enquiry have been given by Mill.

Method of Agreement

The method of agreement states that if two or more instances of the phenomenon under investigation have only one circumstance in common, the circumstance in which alone all the instances agree is the cause (or effect) of the given phenomenon. Suppose that a man suffers from pain in the eyes in the afternoon, every day. In order

to find out the cause of the pain, he takes note of the antecedents and finds that while other factors vary from day to day, rambling in the sun is there every day. So he concludes that rambling in the sun is the cause of pain in the eyes. This is called the method of agreement because the basis of the conclusion here is provided by the fact that the instances in which pain occurs agree only in respect of the cause—rambling in the sun. This method eliminates in a causal situation those factors which cannot actually be the cause.

Criticism

1. It is very difficult to know all the required types of causes for an effect.
2. All the causes may not be known antecedently.
3. For some phenomena, the cause may not be known.
4. Unless an analysis of an instance into its factors could be found prior to the use of the method, the method becomes useless.
5. The method itself cannot determine whether the analysis is adequate or not.
6. The method cannot function unless assumptions about relevant factors are made.
7. It cannot be said with certainty that a cause is invariably an antecedent of an effect. If something is true of some cases, it does not necessarily follow that it will be true of all cases.
8. The inadequate analysis may lead to wrong conclusion. Sometimes, common factor may be irrelevant.
9. A single cause or factor may be a necessary condition for a phenomenon but may not be a sufficient condition.

Method of Difference

In this method only two instances are required. The two instances resemble each other in every other respect, but differ in the absence or presence of the phenomenon observed. The method states that if an instance in which the phenomenon under investigation occurs, and an instance in which it does not occur, have every circumstance in common save one, that one occurring only in the former; the circumstance in which alone the two instances differ, is the effect, or the cause, or an indispensable part of the cause, of the phenomenon.

Let us take an example given by Mill. A man in the fullness of life is shot through the heart; he is wounded and dies. Here, the wound is the only differentiating circumstance between the man alive and the man dead. Hence, the death is caused by the wound.

Criticism

1. The instances are to be observed by experiment in this method. But under simple observation, the conditions cannot be controlled and so it cannot be ensured that all other factors are exactly the same.
2. It does not say that particular cause and effect are permanently related.
3. Because of the possibility of inadequate analysis, the possibility of plurality of causes remains present here.
4. The single factor of difference may be a complex factor involving more than one factor and may require further analysis. In such a case, the method is vitiated.
5. The single factor of difference may be only a part of the cause, and not the entire cause. The method fails to distinguish between a condition and a cause.
6. The method may incorporate the fallacy of *post hoc ergo propter hoc*. The fallacy is committed when we say that since an effect is consequent to a cause, the effect is because of the cause. An effect may follow after the introduction of a cause, but still the cause may be irrelevant. If a man sings and another person immediately becomes senseless, this does not justify the conclusion that singing is the cause of senselessness.

Joint Method of Agreement and Difference

The method can be stated like this:

If two or more instances in which the phenomenon occurs have only one circumstance in common, while two or more instances in which it does not occur have nothing in common, save the absence of that circumstance; the circumstance in which alone the two sets of instances differ, is the effect or the cause, or an indispensable part of the cause, of the phenomenon.

According to this, we require two sets of instances. We have already seen that rambling in the sun is the cause of pain in the eyes. Suppose, the man further observes that he does not feel pain in the eyes on those days when he does not ramble in the sun. Now, he gets another set of instances in support of his conclusion regarding pain in his eyes. Not only the presence of the antecedent regarding the sun is followed by the presence of the consequence of rambling in the eyes, but the absence of rambling is also followed by the absence of pain in the eyes. This is the joint method of agreement or the method of double agreement. The positive instance agrees in respect of the presence of the cause, and the negative instance agrees in respect of absence of the cause.

Criticism

1. Negative instances may not always be relevant. We can have any set of instances as negative instances, even though they may not have any relevance to the phenomenon under investigation.

2. As a method of proof, the method would essentially suffer from the same defects as the method of agreement has.

Method of Concomitant Variation

It states that whatever phenomenon varies in any manner, whenever another phenomenon varies in some particular manner, is either a cause or an effect of that phenomenon or is connected with it through some fact of causation. If the antecedent and the consequent vary concomitantly, the antecedent is regarded as the cause and the consequence, the effect. The method is quantitative and needs statistical technique for measurement. In this method, control should be imposed in such a way that other factors remain constant. But in a social science, the fulfilment of this condition is very difficult. The method is suitable for cases involving factors which can vary quantitatively but cannot be excluded completely.

Criticism

1. The method by itself cannot discover causal connections. If cause and effect are given, the magnitude of increase or decrease, however, can be determined.

2. Unless all the instances are properly analysed, the variation of a particular factor cannot be related to effect.

3. Variation will not produce any effect beyond a particular limit.

4. Mere concomitant variations between two phenomena do not establish causal connection between them.

Method of Residues

The statement of this method is: subtract from any phenomenon such part as is known by previous inductions to be the effect of certain antecedents, and the residue of the phenomenon is the effect of the remaining antecedents. This method is based on the principle of elimination. It also follows from the principle of causation that the same cause has the same effect; and same effect has the same cause.

An example will clear the meaning of this method. Suppose a sack full of rice weighs 80 Kg., and the sack itself weighs 2 Kg. (which is already known), then the weight of rice is 78 Kg. The weight, 2 Kg. is the effect of the sack and the weight, 78 Kg., is the

effect of the rice. Here, the residue is 78 Kg. Residue implies what remains.

Criticism

1. This method can only work by making use of some causal connections which are already known.
2. It tells us that the residual effect is due to the residual cause. But it cannot tell us what the residual cause could be.
3. Unless the effect of the factor which would be deduced is known, no subtraction from the total effect is possible.
4. When there are various factors about which we do not have any previous knowledge, the method cannot help us.

Conclusion

The canons of experimental enquiry are not capable of demonstrating any causal laws. Experimental enquiry does not lay down any method of proof or discovery. It only describes causal or invariant relation. It only defines the relation of cause and effect. But with the help of these methods, false hypotheses may be eliminated and the field of enquiry may be narrowed down. Even if we cannot eliminate all irrelevant circumstances, they help in establishing the condition on the basis of which we can logically prefer one hypothesis to another, thereby bringing economy into our search for real truth.

Uniformity of Nature

The belief that experimental methods can lead to universal and invariable connections, is based on the belief of uniformity of Nature. According to Mill, the process of induction requires the assumption concerning the order of the universe. The assumption is: "What happens once, will, under a sufficient degree of similarity of circumstances, happen again".

The principle states that Nature is uniform. Uniformity means sameness. It presupposes that in spite of changes, Nature remains the same. In Nature, changes take place in a uniform way. A particular change takes place under certain specific conditions and certain changes will occur only under certain conditions. There are orders in Nature and not chaos. If the conditions remain the same, the same phenomenon will occur; and if same phenomenon occurs, the same conditions must be there.

Uniformity of Nature in some form is necessary for induction. According to Mill, uniformity of Nature appears as the "ultimate major premise of all inductions". If an inductive argument is thrown into a series of syllogisms, one may arrive by more or fewer steps at

an ultimate syllogism which will have the principle of uniformity of Nature as its major premise.

Criticism

1. The principle of uniformity of Nature states that "what happens once, will, under a sufficient degree of similarity of circumstances, happen again". This statement is vague. The principle does not tell us what the sufficient degree of similarity is. In order to determine the material circumstances of a phenomenon, we must rely on other criteria, and not on uniformity of Nature.

2. The minor premise of an inductive syllogism being a particular proposition, if we introduce the uniformity of Nature as the major premise, the premises become insufficient to demonstrate a universal conclusion.

3. "The principle does not demonstrate that every pair of phenomena are invariably related. It simply states that some pairs are so connected."¹

1. Cohen and Nagel, *op. cit.*, pp. 268-269.

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Concepts

Meaning

A concept is a word or a phrase which symbolises the phenomenon and helps to communicate the finding. For instance, multiplier, marginal efficiency of capital, labour etc., are all concepts.¹ But a concept should not be confused with the phenomenon itself; it only symbolises the phenomenon. Concept is abstracted from the sense perceptions. It has meaning only with reference to a theoretical system. Concepts are logical constructs created from sense impression or complex experiences. Concepts symbolise the empirical relationship and phenomena which are indicated by facts. Thus, concepts and facts are not the same things. A fact is a logical construct of concepts. The process of conceptualisation arises out of abstraction and generalisation of sense impression.

The object of concepts is to study, organise, manipulate and isolate the properties of objects. The act of isolation of properties requires thinking which can proceed by giving names to such properties. Therefore, conceptualisation is essential to the processes of thought and scientific technique, since it renders precise meaning for communication and brings about economy in the use of language. Concepts are not only basic to scientific method, but they are the foundation of all human communication and thought.²

In a science, concepts must be communicable in a special sense. They must be constructed in such a way that their components are known. Clarification of the elements of such a construct is the main function of definition, which is considered basic to the general problem of conceptualisation. The process of communication becomes difficult between individuals who do not share the conceptual system. Concepts develop from a shared experience. The development of a conceptual system is very much like the development of a new language.

1. M.H. Gopal, *An Introduction to Research Procedure in Social Sciences*, Asia Publishing House, p. 109.
2. Goode and Hatt, *Methods in Social Research*, McGraw-Hill, p. 43.

Categories

On the basis of origin, concepts may be classified into two categories: (i) postulational concepts and (ii) intuitive concepts. The first type has its meaning only with reference to some deductively postulated theory. Its meaning will be different when it will be used in some other context or theories. For instance, the concept, "elasticity", has one meaning in economics and another meaning in physics. As Prof. Northrop observes, no concept carries its meaning intact from person to person and from theory to theory. Each concept is relative to the postulate of the system of the scientist or philosopher who makes use of it. Intuitive concept has a particular meaning. The meaning is never changed by the people who use it. This type of concept denotes something, which is immediately apprehended, e.g., 'red' as colour. Its meaning is abstracted from a wider and empirical context. Intuitive concepts are divided into two forms in theoretical logic—those by sensation and those by introspection. Similarly, postulational concepts are divided into those by imagination and those by intellection. However, for the matter of social science research, such classification and sub-classification do not convey any special significance.

Features

In every field of study, concepts are used to convey special meaning. The concept, in each area of study, is like a code language which is not easily understood by others belonging to different disciplines. Thus, the concepts of physics are not easily understood by the sociologist or economists. "Each concept, in short communicates to the specialist a vast amount of experience, abstracted and clarified for those who understand the term". Therefore, the basic equipment of any student is the knowledge of scientific vocabulary adequate to understand the conceptual development of his area of interest. Concepts should be precise, comprehensive and clear. There should be no misunderstanding about them. Sometimes common words and phrases are given special connotation to make them concepts, e.g., multiplier, indifference curves, games theory etc. All these are common words but they have got altogether different conceptual meanings.

A term may have different connotations in different sciences. A term may refer to different phenomena. For instance, the term "function" has got different meanings in different fields. In social anthropology, it denotes the contribution which a given belief or practice makes towards the continued existence of the society. In mathematics, we express one phenomenon (say, demand) as a function of another phenomenon (say, price). In socio-economic analysis, function refers to occupational phenomena. Therefore, one has to be cautious in using such a concept. Concepts must not have

multiple meaning. It is possible that different terms may refer to the same phenomenon; and there may be the danger of overlapping of meaning, for instance, marginal utility and final utility. A term may have no immediate empirical reference at all. This makes concepts less well-understood. These concepts have as referents the logical relationship between other concepts. For instance, 'social structure' being the structure of a group, is not subject to physical measurement. Such a concept has a very complex series of referents. However, ultimately there is an empirical referent; but it is not immediate.

How to Use Concepts

In research, the proper concept has to be carefully chosen and its usage should be explained thoroughly. A proper definition of the meaning of the concept is something which cannot be avoided. The meaning of the concept does not remain fixed all the time. The meaning of the concept is modified with the accumulation of knowledge. In course of time, some concepts may become outmoded and irrelevant, and therefore, they are discarded. As the focus of a science changes, attention may be concentrated on different aspects of the same concept in such a way that its meaning is ultimately changed. Concepts grow with the increasing experience of the scientists. Thus, instead of using 'status' alone, we may use 'status', 'rank', 'position' etc.

Conceptual difficulties and ambiguities may be reduced by joint discussion and research. As science progresses, conceptual difficulties are cleared away. Every researcher must learn the conceptual tools of his field. When ambiguity arises, he must become aware of the ambiguity. There must be some process of clarification of thinking about the concepts used in research. This may be called the process of re-conceptualisation. It requires a great deal of patience and care for such refinement, but the trouble is paying, as it brings to the surface many of the complex problems. Re-conceptualisation assures more fruitful hypothesis. Its main aim is to integrate different levels of observation and theory. It should not be considered as a method of manipulation of concepts, but as an attempt to isolate and collate behaviour in many fields. Exhibitionism on the part of the new researcher through manipulation of concepts, and giving new names to old concepts, is foolish, and should be avoided by scientists who are after truth and not after words.

For avoiding this superficiality, one must have full command over concepts. Their connotation, significance and usage must be understood precisely and clearly. Sometimes concepts may be vague and ambiguous, as the "socialistic pattern of society" in India. Such concepts should be recognised, if they are to be scientific, and meaningfully applied. This will save the investigator from many a difficulty.

The use of over generalised concepts, like 'function', 'nationalisation', 'modern society' etc. should be avoided. If possible, the general concepts should be translated into concrete concepts with reference to the context. A little reflection and patient search will help in getting concrete concepts. The use of concepts in one context, developed altogether in different context, involves considerable risk, particularly when the concepts become the basis for policy prescriptions. For instance, the classical concept of full employment cannot be used in the same sense as the modern concept of full employment. Deficit financing in all the countries does not convey the same meaning. Similarly, underemployment in one analysis may be in terms of time, but in another, it may be with reference to income. Many of the concepts of advanced economics do not work, for explaining the situations of underdeveloped countries. But still, concepts are borrowed. This may be partly due to incapability or unwillingness to coin new concepts, and partly due to the temptation of using known and high-sounding traditional concepts. In order to develop a working definition, considerable research must be done. Operational definition may be more complex and less fruitful than a traditional definition. Operational definition should not be taken as a fashion. We have got to make a conscious choice between precision and significance. However, as research develops in precision and scope, one can find ways to achieve both.

Measurement

Purpose of Measurement

In our daily life, we only distinguish the character and qualities of things, and on the basis of this, we reject or choose certain things. In day-to-day affairs, it is necessary to make judgement upon qualities which cannot ordinarily be differentiated from one another. Propositions affirming qualitative differences are the first fruits of enquiry in sciences.¹ But it is not enough to know only the qualitative differences in daily life or in sciences. It is more necessary to know the magnitude of such differences precisely. This is required for exactitude and accuracy of statements and for discovering comprehensive principles on the basis of which the subject matter can be known to be systematically related. If we can know the degrees of qualitative differences, we can not only rule out errors but can take up adequate measures to control the indicated changes as well if required. In sciences, the accurate measurement of phenomena can give us great practical control over the studied subject, and can make possible the formulation of principles or laws which can make confirmation or refutation unambiguous and clear.

Quantitative distinctions are substituted for qualitative ones, for theoretical and practical reasons. But many people, without knowing the meaning and justification, often use quantitative distinction. For indicating the qualitative differences, the use of numbers requires a careful examination, if we are to avoid absurdity and errors. In order to deal with simple matters in our daily life and in sciences, we need not resort to complicated methods of registering differences. "Measurement, calculation, and the often difficult deduction of consequences from premises, would not require the elaborate techniques which they, in fact, do require". But sometimes a more intricate technique than a bare commonsense method is required for formulating, collecting and estimating evidence. Investigations cannot, perhaps, be properly and fruitfully carried on without the introduction of quantitative methods. Scientific method, therefore, must study the foundations of applied mathematics.

1. Cohen and Nagel, *op. cit.*, p. 289.

Formal Conditions of Measurement

For measuring the qualitative differences, the minimum requirements for employing numbers may be stated in the following first two conditions:

1. In a set of n bodies given, A_1, A_2, \dots, A_n , one must, with reference to a certain quality, be able to arrange them in such a way that between any two bodies one and only one of the following relations holds :

(i) $A_1 > A_2$ (ii) $A_1 < A_2$ (iii) $A_1 = A_2$. On the basis of the signs $>$ or $<$, the qualitative differences in bodies can be studied. The relation $>$ must be asymmetrical.

2. If $A_1 > A_2$ and $A_2 > A_3$, then $A_1 > A_3$. This is known as transitivity condition.

The above two conditions are sufficient for the measurement of intensive qualities, e.g., density, temperature etc. For the measurement of extensive qualities, they are necessary but not sufficient. Measurement of extensive qualities requires some physical process of addition which should have the following formal properties.

3. If $A_1 + A_2 = A_3$, then $A_3 + A_1 = A_3$

4. If $X = Y$, then $X + Z > Y$ (Where the value of Z is not zero or negative).

5. If $A = X$ and $B = Y$, then $A + B = X + Y$

6. $(A + B) + C = A + (B + C)$

If these conditions are satisfied, measurement becomes possible. With the fulfilment of first two conditions, it cannot be said that all the six conditions hold. If the I.Q. of a man is twice that of another, we only mean that the first man is higher than the other on a specific scale of preference. It is absurd to say that the first has twice the intelligence or training, because operation for adding intelligence or training has been found out which is consistent with the last four essential conditions.

Nature of Counting

Counting is a method of judgement of enumeration. In actual counting, classification and analysis are required, and enumeration of instances is helpful for induction. In order to more exactly enumerate the parts of which a whole is composed, we require weighing or measuring. There is no essential difference between weighing and measuring. In measurement, we make comparison. In measurement, we express the relation of the parts with some common standard or unit. Through measurement, the things are reduced to common terms. It is really the business of the physio-mathematical

sciences. Counting and measuring help us in achieving the exact body of knowledge which we call science.

Counting gives us the exact knowledge and tries to avoid the vague ideas. When we suspect significant connections between groups counted, counting is taken up. Counting makes our ideas precise and it helps us in distinguishing various features of different groups. However, only a discrete group can be counted. The number of individuals in a group represents an invariant property of the group. From this arises the great importance of counting as a method of clarifying our ideas. Applied arithmetic is partly a collection of rules through which the invariant property can be easily discovered. Counting must be objective.

It is very difficult to count unless we know that what it is that we are counting. Where the difference between the groups is not distinct, the interpretation of the number obtained by counting is uncertain. Thus it is not easy to draw the line of demarcation between skilled and unskilled workers. In a social science research, the information which we get from the questionnaires is not always reliable, because the questions themselves may be ambiguous or not very clear or distinct. The answers may also be affected by ignorance, dishonesty and vanity. However, if the groups are very large in numbers or difficult to examine exhaustively, then enumeration is not undertaken. In such cases, sampling method is practised.

Measurement of Qualitative Data

In social sciences, we face problems which are subjective and qualitative, e.g., skills, values, attitudes, utility, etc. Qualitative data cannot be quantitatively or objectively measured. But qualitative data cease to be of much scientific value unless such data are quantified.

Prof. Menegazzi² pleads for greater attention to the qualitative aspect of social life—to the synthetic or aggregative approach to the problems. It is to some extent possible to measure the intensive and extensive qualities. The qualitative data can be translated more or less satisfactorily to quantitative terms. The technique of such translation has several steps: description, categorisation, and determination of quantitative incidence and inter-relations.³ These steps are generally known as "content analysis".

Measurement of Intensive Qualities

There are some things e.g., hardness, density, intelligence, etc. which have non-additive qualities. These qualities are called intensive qualities. These qualities can be measured only in the sense that the different degrees of the quality may be arranged in a series. In this

2. G. Menegazzi, *Method and Foundations of Social Science*, 1957.

3. M.H. Gopal, op. cit., pp. 204 ff.

case, the questions regarding "how much" or "how many times", are meaningless : the qualities cannot be added.

Characters of things cannot always be distinguished, because they form a continuous series with one another. Sometimes it is sufficient to know that one piece of wood is harder than another. But if we want to know how hard one piece of wood is as compared to another piece, then we require a very certain and uniform criterion. The varying degrees of quality can be indicated by assigning different numbers—e.g., 1, Q. of A is 50, and 1 Q of B is 100 etc. But in this way we cannot get the correct measurement. It should not be considered that measurement requires nothing more than the assigning of numbers. But by assigning numbers, we can only indicate the degrees of intensity i.e. which one is higher and which one is lower. In the above example, it should not be interpreted that B is twice as intelligent as A. Such a precise measurement is not possible in the case of an intensive quality by assigning numbers. All qualities cannot be measured in the same sense.

Numbers have three uses to perform:

- (i) As identification marks or tags.
- (ii) As signs to indicate the position of the degree of quality in a series of degrees.
- (iii) As signs indicating quantitative relations between different qualities.

(i) Sometimes numbers can be used to indicate names or identity, e.g. convict No. 100, convict No. 200, etc. Numbers are more convenient than verbal names for various reasons. But the assigning of the numbers does not indicate any relation between the objects numbered corresponding to the numerical relation between the assigned numbers. Thus, convict No. 100 is not twice as criminal as the convict No. 50.

(ii) "A scientifically more important use of numbers is when the order of numerical magnitude is the same as the order of the position of the character studied, in a scale or ladder of qualities."⁴ Intensive quality can be arranged as a relational property. For example, if, by experiment, we can show that diamond is harder than glass, and glass is harder than pine-wood, then we can show that diamond is harder than pine-wood. Here, relational property is transitive. The relational property is said to be asymmetrical, if A_1 is harder than A_2 , but A_2 is not harder than A_1 . By arranging the bodies in a linear series, according to quality, we can get a scale or ladder of this quality.

If the relation of magnitude of numbers is asymmetrical and

transitive, we can arrange different unequally hard bodies, e.g., A_1, A_2, \dots, A_{100} (A_1 is the hardest and A_{100} is the softest body), and we may assign numbers to them to indicate their relative hardness in such a fashion that the order of numerical magnitude is the same as the order of relative degrees of hardness. We may assign the numbers 1 to A_1 , 2 to A_2, \dots and so on; or 5 to A_1 , 10 to A_2 and so on. However, we should not say that A_2 is twice as soft as A_1 . Such an interpretation is meaningless, because we have only prepared a scale, but we have not exactly measured the qualities. Since, quality cannot be added, it is difficult to make quantitative comparison of qualities. The scale cannot speak anything about the quantitative aspect.

Measurement of Extensive Qualities

There are some things the qualities or properties of which are additive, e.g., areas, angles, electric current, lengths etc. The properties which are additive are called extensive properties. (iii) Numbers can be employed to measure the quantitative relations. In order to measure the weight of something, we are to construct a scale or ladder of weights. By the measurement of weight with the help of a scale, we can know experimentally whether A is heavier than B or not. The relation, "heavier than" can be, thus, experimentally known to be transitive and asymmetrical. When we measure with the help of a scale, one of the three possibilities is apparent:

- (i) A is heavier than B
- (ii) A is equal to B
- (iii) B is heavier than A.

Since weight can be added, we can say, for instance, that A is twice B in weight, or A is equal to B in weight, and so on. Now, suppose the weight of A is regarded as the unit or 1, and that we assign weights to other things by this process so that A_2 is equal to 2, A_3 is equal to 3, and so on. Then, will $A_1 + A_2 = A_3$? We cannot say anything about it certainly, unless we make the experiment. In pure arithmetic this is true, but in physical operation of addition of weights, unless experiment is made, we cannot say with certainty whether such operation will conform to the properties of 'pure arithmetical addition or not. The formal properties of arithmetical addition will be found to be true only in some cases of physical operation of addition of weight, but not in all cases. However, the method of measurement of weight can be extended to measure other properties. Cohen and Nagel call such measurement fundamental.

Steps in Measurement Through Content Analysis

1. It is necessary to know the characteristics of the content i.e. description, categorization, inter-relations etc. The substantive

nature of the content must be known and the data should be compared at different points of time.

2. The concepts should be precisely defined and the data should be specified.

3. Content analysis must present the picture, intentions, psychological state and cultural pattern of the communicator.

Categorization : The attributes must be categorised. Categorisation should be based on explicit agreement. The operational definition of every category is necessary. Categorization is required for the quantification of the attributes. The categories must form a continuum, i.e., an identifiable and logically related series. Every group should be distinct. The coding of qualitative materials can be done by noting the presence or the absence of an attribute. This is known as the dichotomy approach. The degree of intensity can be recorded by ranking the material i.e. by means of the preparation of a scale of intensity. The formation of a graduated series, can be done if the data are scalable. Another method is the introduction of equal intervals in the scheme of categories i.e. variables. But this method is not possible in all cases. This can be utilised where money unit, time etc. are involved.

Validity and Reliability : A scale is reliable if it gives the same result consistently when applied to the same sample.

In scaling technique, different methods are applied for testing reliability :

- (1) The scale may be applied to the same population twice over.
- (2) The scale may be constructed in two forms and be applied to the same sample. "The greater the correspondence between the two, the greater is the reliability".
- (3) The scale itself may be divided into random halves. The degree of correlation between the two halves, would mean the degree of reliability.

Validity implies that the scale actually should measure what it claims to measure. If the items are carefully selected, and the continuum is set up, validity follows logically. Validity may be tested by the help of the opinions of the experts. Independent alternative criteria may be taken up to test the validity of a particular method of measurement. For instance, under-employment is measured in terms of time, but it can also be measured in terms of income. The two methods may reinforce each other. In order to study a phenomenon, it is best to utilize all the possible methods. In a scale, the qualitative items may not have equal importance. Thus, it is necessary to give suitable weightage to the more important items, as is

done in the preparation of index numbers. This will increase the validity of the scale. However, in social qualitative measurement, absolute reliability and perfect validity should not be expected.

Some Other Requirements for Measurement

For effective measurement, the unit of enumeration must be determined. Either a single respondent, or a part of the content may be taken as the unit of enumeration.

It is better to have the same system of categories, same units of enumeration and the same operational definitions. In order to know quantitatively the degree of deviation, it is very necessary to have certain norms.

The tools of measurement of qualitative data can be applied if the following steps are taken:

1. The data should be specified, and a matrix should be developed with an attitude scale and scoring devices.
2. The coded data should be properly tabulated.
3. A list of variables in terms of which the content is to be coded, should be prepared.
4. The categories of each variable should be filled in. The categories should not be either too broad or too narrow.
5. Proper definitions and procedures should be used.
6. The outline of the analysis may be prepared, in the fashion of a pilot survey.

The success of measurement depends on the theoretical procedure, and on the coders. The method of measurement should be, as far as possible, accurate, and, the coder must be neutral, alert, trained and painstaking.

Numerical Laws

Numerical laws play an important role in scientific methodology. Such laws connect physical properties, and can measure many intensive properties e.g. density and temperature. The aim of science is not only to establish such laws singly, but also to find out how numerical laws are themselves connected with one another. However, unless some properties were measurable by a fundamental process, numerical laws would be difficult to find out, and the derivated measurement of intensive qualities cannot be undertaken. Since fundamental measurements of social phenomena are difficult, and since there are only few numerical laws connecting intensive and

extensive properties, social sciences are faced with difficulties in measuring intensive qualities. General invariant laws can be discovered only when the different properties of bodies are distinguished through successful techniques of measurement.

Statistical Methods

Need for Statistical Methods

Statistical methods are a mechanical process especially designed to facilitate the condensation and analysis of the large body of quantitative data. The aim of statistical method is to facilitate comparison, study relationships between the two phenomena and to interpret the complicated data for the purpose of analysis. Many a time, comparisons have to be made between the changes and results which are due to changes in time, frequency of occurrence, and many other factors. Statistical methods are used for such comparisons among past, present and future estimates. Such methods, e.g. extrapolation, can be applied for the purpose of making future forecast about the trends of, say, demand and supply of a particular commodity. The best result from a particular cause on a particular phenomenon can be ascertained by using statistical tools like the techniques of variance and co-variance.

Statistical methods are applicable to a subject where enquiry and investigation are essential to arrive at the truth. Scientifically analysed data are the foundation of sound policy formulation. The use of statistical methods can be helpful in enlarging human experience and knowledge. They are techniques required for handling the multitudes of numerical results in such a way that the significant relationships between properties can be studied. The method of concomitant variation, when applied to varied instances, requires statistical techniques. These methods are not merely important for collection of data, but also for compressing and summarising as well. Certain things cannot be predicted with accuracy, but still, the comparison of large collections of data sometime helps in finding out a few correlations. "The methods used to evaluate group phenomena by an analysis of data supplied by enumeration and measurement comprise the science of statistics".

Numerical data can be simplified by classification, the nature of which depends upon the purpose of enquiry. Frequency table is helpful in giving an overview of the materials. The distribution of

frequency intervals is expressed with the help of two numbers : (i) statistical averages and (ii) dispersion or deviation number. The former describes the position of distribution, the value around which the items centre. The latter gives the extent of variations of items with reference to an average.

Be that as it may, the statistical methods are applied to simplify a huge body of data into a simple statement of facts and tendency. But the fact remains that statistical methods cannot be as accurate as experimental methods.

Steps in Statistical Methods

Statistical method has been defined "as the collection, presentation, analysis, and interpretation of numerical data". Thus, statistical method involves four steps :

Collection of Material : In order to have a reasonable standard of accuracy, data must be collected in a systematic manner. The data should be reliable, purposeful and adequate. The data are observed, counted and analysed in a systematic manner with reference to the problem. The facts are to be collected from a large area. The data are collected by four methods : (i) Library method, (ii) Experimental method (iii) Observation method and (iv) Questionnaire method. However, it should be noted that only the relevant data should be collected carefully.

Presentation of Data : After collection the data should be suitably classified. Classification is the process of arranging things with some purpose—with respect to some variables or attributes. The classified data should then be presented in a clear manner either with the help of diagrams or with the help of graphs.

Analysis of Data : The classified data then should be properly analysed with the help of statistical tools, like average, dispersion, correlation, association etc. The analysis involves mechanical processes, and it requires the knowledge of the application of statistical techniques. In analysis, the significant facts are abstracted from the huge body of data.

Interpretation of Data : It involves the study of those techniques by which inference or conclusion can be drawn correctly. We must be able to interpret what the data tell us. It should be noted that the interpretation must be with reference to the studied data. If the data are not sufficient, the inference becomes only probable.

Application of Statistical Method

Statistical approach is a quantitative micro-approach. It is thus inadequate for social analysis, because the social problems require a macro-approach—a qualitative analysis.

Statistics studies the individual traits in a large number of separate units and takes a horizontal view of society over a large body of data. The classes of facts to which statistics is applied have two characteristics :

(1) The classes of facts are very complex. The data are affected by a multiplicity of causes.

(2) The facts are of such a nature that the laws underlying the event or phenomenon to be investigated, cannot be directly made applicable.

Thus, (i) statistical method is applied to those facts which cannot be counted or measured. (ii) In order to determine the death-rate of a particular society, we cannot apply any law or principle. So, one has to count physically the actual number of deaths. Experiment in such a case is impossible. However, where general laws can be applied or experimentation can be made applicable, we need not use statistical method. In Astronomy, laws are discovered by which the eclipses of the sun and the moon can be known even for a very long period. Thus, in this case, it is not necessary to apply the statistical method. But there is no law to know meteorological changes. Hence, statistics can be applied to know the meteorological changes, like changes in weather etc.

The statistician selects certain specific factors involved in social institutions and manipulates them so as to discover the involved relations. Statistical technique is concerned with the nature of the common denominators and can only correlate a few factors. Any case study, however has to turn to statistics if its data are to reveal frequencies, types, trends, uniformities and so on. The case study technique and the statistical method are complementary to each other.

Advantages and Uses of Statistics

1. Statistics makes a comparison between present and past data possible.
2. It is also useful for making projection and extrapolation.
3. Certain important correlations and association of attributes can be found with the help of statistics.
4. It explains facts by revealing quantitative uniformities and relations between facts.
5. It enables us to form a probable inference by calculation of chances and estimation of probabilities.
6. It describes facts precisely through convenient presentation of facts and data.
7. It leads to economy and high degree of flexibility.

8. It is useful for the study of management, economics etc., and it is very helpful to bankers, state, planners, speculators, researchers etc.
9. Its approach is quantitative and hence, definite and reliable.
10. It enables us to give a horizontal view of society across the vast area of data.

Distrust and Misuse of Statistics

Statistical methods are only tools. As such, they may be very often misused. It is said that figures cannot prove anything. Some people regard statistics as the worst type of lies. There are three types of lies—lies, damn lies and statistics. Statistics are the lies of the first order. An ounce of truth can produce tons of statistics. Mere quantitative result, or huge body of data, without any definite purpose, can never help to explain anything. The misuse of statistics will arise from the following situations :

- (1) Analysis without any definite purpose
- (2) Carelessness in the collection and interpretation of data,
- (3) For misleading others, and for self-interest, some unscrupulous persons may cook up data.
- (4) Pressure on statisticians, and bias and prejudice of the statisticians.
- (5) Wrong definitions, inadequate data, wrong method and inappropriate comparison etc.

As a principle, statistical method cannot prove anything; but it can be made to prove anything. The fault lies not with statistics but with the person who is using statistics. Figures cannot tell lies, they are innocent. The tools must be used correctly without any bias. The science of statistics is a most useful servant; but it is only of great value to those who understand its proper use.

Dangers and Fallacies in the Use of Statistics

Statistical methods, though very useful, can lead to the following dangers and fallacies:

1. Statistical numbers supply information about the characteristics of the group, but they do not speak anything about any individual item. From the knowledge that male-female ratio is 1:2, one cannot say anything about the number of males or females in a particular family.

2. Statistical averages cannot represent an invariable relations in a group. The number of divorces may be 500 per year over a long period of years; but it does not follow that this number of divorce

must occur annually. The variation may be caused due to a number of factors.

3. Co-efficients of correlation are not free from defects. Pearson's definition states that any two groups may be investigated for knowing the extent of correlation. But the groups may be quite independent of each other. The spread of cancer in England was shown to be correlated highly with the increased import of apples. The correlations of this nature are generally absurd, and do not show any causal significance. It is really difficult to interpret a coefficient, because its value may be consistent with a number of hypotheses. Therefore, invariable connection cannot be sufficiently proved by a high co-efficient of correlation. Increased number of arrests do not lead to the conclusion of increased number of crimes; the former may be due to severity in law enforcement.

4. Frequent associations between two events often lead us to the erroneous belief that they are invariably connected. We may find that in 9 cases out of 10, rich people are bald-headed. But from this we should not infer validly that riches and baldness are connected in some special way. People other than bald-headed ones may also be rich.

5. High coefficient of correlation can be found by mixing two sets of data in which generally no correlation is to be seen. If in one community the coefficient correlation between the ages of husband and wife is 0.856, it does not follow that the same will be true of another larger community. Co-efficient is subject to variations in sampling. A relatively high correlation sometimes may be only casual.

6. When sampling is not fair, adequate or representative, it may lead to dangerous fallacies. During the Spanish-American war, the death rate in USA Navy was 9 persons per thousand, and for the same period death rate in New York city was 16 persons per thousand. This does not lead to the valid conclusion that the Navy was a safer place than New York city. Because the error was that in calculating the death rate of New York, the mortality of infant, old and diseased people was included, whereas in the case of Navy this was not done.

7. Sometimes absolute numbers are used in comparing two groups, and percentages are neglected. This becomes a source of fallacy. If percentages are calculated, perhaps one would find a different story, in so many cases, than what the numbers say. If we compare the marks obtained by two students, A and B, we may have a hurried impression that A, who has got 500 marks, is a better student than B, who has obtained 480 marks (out of full-marks 1000 and 800 respectively). But the percentage calculation which is more sensible here, will tell us that B is a better student than A.

8. Fallacy may arise when comparison is made on the basis of units or classification without regard to value or meaning of the units.

Money income of a man might have increased this year, compared to the previous year. But this does not justify the conclusion that he is better-off, because the value of money might have gone down to a greater extent than the increase in income, as is evident in some of the developing countries.

9. Another important source of error is neglecting to differentiate changes in the definition of subjects or in the method of collection of data. Such changes may occur from census to census. As Falker observes, it is possible to lower infant mortality without saving a single infant life, by improving the birth-registration.

10. Different results may be obtained for a social phenomenon by applying different norms or units to make comparisons. There are different methods for measuring a certain feature. For instance, efficiency can be measured by productivity, or profit or out-put or cost. All these norms will not give the same result. The acceptance of a particular norm is neither fool-proof nor non-controversial.

11. The appearance of precision introduced by statistical methods is misleading, if one thinks that the correctness of the data is enhanced by them. Where inconsistency of data is not apparent, more thorough methods should be used for testing consistency.

However, we may conclude with the words of Marshall who says, "statistical arguments are often misleading at first but free discussion clears away statistical fallacies".



Probability and Generalisation

Meaning

In scientific method, probability means anything between certainty and impossibility. But in popular meaning, probability is something which is more likely to happen than not. In the scientific sense, probability is a matter of degree, ranging between two extremes—impossibility and certainty. Theoretically, it is a measure of likelihood of occurrence of a chance event. This theory is based on the belief that the same set of causes is accompanied by the same effect. Thus, the question of belief is always related to the concept of probability. Probability is equal to the number of ways favourable to the event, divided by the total number of ways, both favourable and unfavourable. Probability is sometimes represented as a fraction, and sometimes it is represented as a proportion. The question of elimination of chance is bound up with the question of probability. When we cannot certainly predict the occurrence of an event, due to our imperfect knowledge, we have got to estimate its probability.

Nature and Grounds of Probability

According to some logicians, the ground of probability is purely subjective, i.e., it depends on our personal belief. But according to some other Logicians, the ground of probability is objective, i.e., probability depends on experience. However, probability is neither simply subjective nor simply objective. It is both subjective and objective.

"Probability refers to the likelihood that a given statement is a true statement. This conception of probability relates to the amount of knowledge lying behind a statement whose probable truth is being evaluated."¹ "Probability is a type of inference which aims at providing a mathematical calculation of the likelihood that every possible alternative should lead to certain event." In other words, probability is concerned with the calculation of chances of every possible alternative to give rise to an event. Probability is an attempt

1. Goode and Hatt, *Methods in Social Research*, p. 210.

to provide the determination of an event quantitatively by eliminating chances. Probability attempts to provide a rational explanation through the introduction of mathematical calculations by eliminating chance, which has no place in logic. But probability calculation is never certain; and it only gives the probable result.

The numerical value of probability lies between zero and one. Probability is a positive number but not greater than unity. If an event is certain to happen, its probability is one; and if it is certain not to happen its probability is zero. One can get the idea about probability only when certain conditions are fulfilled. These are:

- (i) the events must be mutually exclusive;
- (ii) the events must be exhaustive;
- (iii) the events must be definite;
- (iv) the events must be equally likely.

The probability of an event can be found out only after conducting a large number of similar experiments. But if we want to find out the probability of an event prior to conducting experiments, we use the principle of indifference or the principle of insufficient reason. This principle proposes that whenever there is no basis for preferring one event over others, all events should be treated as equally likely. All events are reduced to equally likely simple events and then the ratio of favourable events to total number of equally likely events, is taken. This is known as *a priori* theory of probability. Thus, the probability of obtaining 9 in rolling dice is zero and of obtaining less than 9 is one.

The probability of an event changes as conditions regarding its sample space change. It is meaningful to talk about the probability of an event only if we specify a sample space in which the event is represented by either a simple or a compound event.

Probability and Inductive Generalisation

Induction and probability are mutually related. It is believed that probabilities are based on induction. However, Jevons observed that induction is based on probabilities. The causal connection in induction is never certain. Our knowledge is imperfect, and there is the possibility that certain causes are existing although we do not know them. These causes may produce unexpected effects. The conclusion in an induction is only probable. However, the induction forms the objective ground of probability, because the material for our probable conclusion are derived from our experience. A probable argument is that type of argument where premises only justify probable conclusion. The conclusions of simple induction, analogy, etc., are only probable and not certain. In simple enumeration, no causal connection is known to exist definitely. Similarly, in analogy the argument is based on

imperfect resemblance. Since in induction all the possible and relevant cases cannot be observed and studied, induction yields only probable generalisation. When we say that the generalisation is valid in many cases or in most of the cases, we only speak about approximate generalisation. The degree of probability of an approximate generalisation depends on the proportion between the agreeing instances and non-agreeing instances. However, in our daily life, we use approximate generalisation or probabilities. Hence, Bishop Butler has rightly pointed out that probability is the very guide of life. In science, the value of approximate generalisation is not very significant. Approximate generalisations may be of two types, e.g., those that are definitely known to be probable, and those which are probable at the present state of our knowledge. The conclusions of simple induction may be taken as the basis of scientific induction. Analogy and approximate generalisations may lead to certainty through the discovery of definite causal connection, and of more relevant facts and figures. When the premise cannot suggest a universal conclusion, the argument becomes necessarily probable. In induction, the inferences that are drawn from approximate generalisations are only probable, and not certain.

Interpretations of Probability²

The origin of probability has been given different interpretations. Two such important interpretations are discussed below :

Probability as a Measure of Belief

According to De Morgan, Laplace and Keynes, probability is identified with the strength of belief. To De Morgan, probability is the state of the mind with reference to an assertion, an event or a matter on which complete knowledge does not exist. When we say that "it is more probable than improbable", we, in fact, believe that it will happen more than we believe that it will not happen. When people do not have omniscience or sufficient knowledge, we have got to rely on probability. If an event is sure to happen, its probability is one; and if it is certain not to happen, its probability is zero. But when our belief is intermediate between certainty of its occurrence and certainty of its non-occurrence, the probability is between 1 and 0. When our ignorance is equally distributed over several alternatives, the calculus of probability may be applied. However, when there is no basis for preferring one event over others all events should be treated as equally likely. This principle is called the principle of indifference, or of insufficient reason. If there is perfect indecision, i.e., belief inclining neither way, we can say that the two alternatives are equally probable. When we are completely ignorant about two alternatives, the probability of the occurrence of

2. Cohen and Nagel, *An Introduction to Logic and Scientific Method*, pp. 164-72.

one of them is $1/2$. When one says that the probability of getting a head in tossing a coin is $1/2$, one has reached this conclusion by reasoning or deductive method. This is the *a priori* theory of probability. Hence, no trial is required before the assignment of probability. The result, here, does not require that a coin be actually tossed, or even be at hand. What is required is the knowledge of the antecedent conditions. As per the *a priori* view, all events are reduced to equally likely simple events, and then the number of ways in which an event can occur, is divided by the total number of equally likely events, and the ratio that is obtained becomes immensely helpful. But the interpretation of probability as a measure of belief has several limitations, such as:

- (i) Belief cannot be satisfactorily and objectively measured.
 - (ii) Belief does not uniformly correspond with the state of facts.
 - (iii) Beliefs about the same events may vary to a great extent.
 - (iv) Mere belief is not enough. It must be based on facts and experience about facts.
 - (v) In order to be meaningful, beliefs have got to be combined. But, in fact, belief cannot be measured.
 - (vi) Unless the range of its application is limited, the psychological theory of probability is prone to lead to absurd results.
- These limitations have led to the interpretation of probability as the relative frequency.

Probability as Relative Frequency

According to this interpretation, probability is not based on subjective feelings, but is grounded in the nature of classes of events. Here, the probability of a unique event is meaningless. This theory is capable of explaining probability judgements that arise out of statistical investigations. In this theory, probability is regarded as the relative concept. The relative frequency theory of probability is an alternative to the *a priori* theory. This frequency theory states that "if a large number of trials be performed under the same conditions, and if the limit of the ratio of number of happenings of an event to the total number of trials is unique and finite, then this limit is known as the probability of happenings of that event".

The relative frequency of an event is equal to the ratio of the number of times the event happens (X) to the total number of trials

(N) i.e. $\frac{X}{N}$. This ratio will assume a definite value, as the number of

trials (N) increases and thereby the value of X is changed (increased). For instance, if a fair coin is tossed, 10 times, 100 times and 1000 times, one may observe the number of heads to be 2,40,475

respectively; and therefore, the respective relative frequency would be $2/10$, $40/100$ and $475/1000$. This demonstrates that as the number of trials increases, the relative frequency approaches $1/2$.

However, no event is inherently probable. An event may be probable in terms of its belonging to a specified class; and this should be explicitly known before evaluating probability. In this theory, probability is defined as the relative frequency with which the members of a class exhibit a specified property. The same event, however, can be assigned different probabilities in different situations. It should be remembered that the probability should be relative to the evidence at the disposal. An event will have different probabilities relative to different amounts of evidence. But in judging probabilities, it will be a mistake to use less than the total amount of available evidence.

The frequency theory is not capable of interpreting what we mean by the probability of theory being true, or by the probability of propositions that are concerned with singular events. But these objections are not serious, and they can be overruled by modifying the technical aspect of the frequency theory.

However, since probability is relative by nature, it is useful to apply probability calculus in the analysis and measurement of probability.

Mathematics or Calculus of Probability

In a sense, the conception of probability is essentially a mathematical one. It is purely mathematical if it is restricted to the question of necessary inference. A few elementary theorems are mentioned below:

1. The mathematical probability of a simple event is expressed as the fraction whose numerator is the number of favourable events (M), and denominator, the total number of alternatives ($M+N$).

$$\text{Or, } P (\text{Probability of the happening of the event}) = \frac{M}{M+N}$$

The events are assumed to be equiprobable.

The sum of the probability of success (P) and failure (q) is $=1$. The value of the probability, which is expressed in fractions, lies between 0 and 1.

2. The probability of the occurrence of the two independent events, is the product of their separate probabilities. Thus, if X and Y are two independent events, $P(x)$ the probability of the first, and $P(y)$ the probability of the second, the probability of their joint occurrence is $P(xy) = P(x) P(y)$. This rule is applied even if the events are not completely independent.

3. The probability of the occurrence of either of the two events that cannot concur (i.e. exclusive events), is the sum of their separate probabilities. For example, if $P(x)$ and $P(y)$ are the respective probabilities of two exclusive events X and Y , the probability of obtaining either is $P(x+y)=P(x)+P(y)$.

If two coins X and Y are tossed together, the possibilities of the falling of head (success, P), and tail (failure, q) are:

X and Y both falling heads,

X falling head and Y tail

X falling tail and Y head

X and Y both falling tails.

The probabilities of:

Two heads (or 2 successes) $= P.P = P^2$

One head and one tail (only 1 success) plus

One tail and one head (only 1 success)

$$= Pq + qP = 2Pq$$

Two tails (or 0 success) $= q.q = q^2$

Here, the probabilities of 0, 1 and 2 successes are given by q^2 , $2qP$, and P^2 respectively i.e. by the successive terms of the expansion of the binomial $(q+P)^2$.

Binomial expansion takes the general form $(P+q)^n$, where n is the number of events. In this case, the probability of a complex event with n components can be obtained by selecting the appropriate term in the expansion of this binomial. When this type of binomial is expanded, the number of combinations increases and the frequencies of each form a perfectly smooth symmetrical curve known as the probability curve or, the curve of normal distribution. This curve is fundamental in the analysis of probability statistics.

4. The probability of cumulative evidence being true, may be calculated by subtracting the product of the separate improbabilities from unity. For instance, if the probability of a witness telling the truth is $9/10$ and the probability of the second witness telling the truth is $1/5$, then, the improbabilities in these two cases would be $1/10$ and $4/5$ respectively. The product of these improbabilities would be $2/25$. By subtracting this product from unity, we get $23/25$. Thus the cumulative value of the evidence, i.e., the probability of the event having actually occurred is $23/25$.

Mathematics is not concerned with the truth or falsity of the premises as such. No purely mathematical theory can perfectly determine the degree of probability of any proposition, dealing with matters of fact. When certain assumptions are made explicit regarding a proposition, mathematics can determine the probability. It

can examine the necessary consequences of these assumptions.

All said and done, it must be admitted that the probability of the theory of probability is very improbable.

Keynes' Ideas on Probability

Keynes' ideas on probability may be found in his *Treatise on Probability* (1921) and in his *General Theory* (1936). In the *General Theory*, Keynes discusses probability with reference to long term expectations.³ He says that in forming expectations, it is not proper to attach too great a significance to the matters which are very uncertain. Keynes does not regard uncertainty as improbability.⁴ The state of long-term expectation depends not only on the most probable forecast, but also on the confidence with which one makes this forecast. Over a long period of time, the actual results of investment hardly agree with the initial expectation. The existing market valuation is not uniquely correct, because the existing knowledge does not provide the sufficient basis for a calculated mathematical expectation. We cannot rationalise our behaviour by arguing that to an ignorant man, errors in either direction are equally probable, so that there remains a mean expectation based on equal probabilities. Keynes observes that "the assumption of arithmetically equal probabilities based on a state of ignorance leads to absurdities."⁵

However, a more thorough treatment of probabilities by Keynes can be found in his *Treatise and Probability*. The fundamental problem connected with the theory of probability is the interpretation of probability. What exactly is the thing whose value is known *a priori* or revealed through the measurement of relative frequency? Some logicians observe that measurement does not go to find the simple numbers alone, but it finds numbers in relation to characteristics that are definable. One must know, therefore, the characteristics which find their numerical expression in the context of probability. Probability being, to some extent, a subjective valuation, the factors that lead to variations in the state of mind must be understood. This is essential for a proper understanding of the nature of probability; and Keynesian analysis is mainly devoted to this consideration. His contribution to the theory of probability lies in the fact that he has given greater definiteness to the loosely used word "Probability."

Probability may be viewed in the mathematical, statistical or logical sense. In the purely mathematical sense, the actual value for the probability is either known or assumed to be known, *a priori*; and then one has to make an arrangement mathematically on the

3. J.M. Keynes, *General Theory*, Ch. 12.

4. *Ibid.*, p. 148 (fn. 1.)

5. *Ibid.*, p. 152.

basis of different values obtained. In the statistical sense, when the actual probability is not known *a priori*, an attempt is made to estimate probability *a posteriori* on the basis of actually observed statistical frequencies. However, in the logical sense, the treatment of probability involves problems which partly belong to the domain of psychology rather than completely to the area of pure logic.

According to Keynes, probability is not concerned with events other than propositions or judgments. In form, Keynesian analysis of probability is symbolic; but in actual practice, he rules out the possibility of mathematical measurement of probability. To Keynes, probability is not a measure of anything; but it is simply a manifestation of an undefinable logical relationship between two involved statements. This logical relationship has two extremes: at the one end, there is full certainty (probability=1), and at the other, there is complete uncertainty (probability=0). However, corresponding to this logical relationship, there may be some actual relation—a causal relation of some nature, as the probability value approaches zero or one.

Probability is based on induction. But inductive arguments were the real targets of attack of the mathematicians in the past. It was not that the inductive methods were false but that their validity, was not established. In this connection Keynes introduced his principle of "Limited Independent Variety". This principle says that the world may not be finite but any property in it can enter only into a finite number of combinations. But if this number is very small, then it will not be able to reflect the complexity of the real world in sufficient degree. The difficulty faced in measuring probability cannot be solved or avoided by Keynes' principle. It is generally said that if the evidence to justify a probability assertion is not sufficient, then the assertion can however be established by referring it to the principle of Insufficient Reason (Equal Distribution of Ignorance). According to this principle, the unknown *a priori* probabilities must be equal when, due to our ignorance, we cannot assign unequal values. Keynes observes that when the probability of an event is not known beforehand, we may regard all possible values of the probabilities, between zero and one, to be equally *a priori*. But Keynes' argument here does not seem to be very sound. Keynes wanted to formulate the principle of Insufficient Reason in a more precise manner. He observed that this principle can be used only till such time as it is appreciated that it cannot be applied to a pair of alternatives, either of which is capable of being further split up into a pair of incompatible alternatives having the form of the original pair.

Be that as it may, Keynes' contribution to the theory of probability was outstanding and original. To him, probability belongs to that part of logic which deals with arguments that are rational but not conclusive. Keynes had been following the English

tradition of Hume, Mill and other noted logicians who preferred matters of fact, and conceived logic as a branch of Science rather than of imagination. The entire approach of Keynes, so to say, is based on the principles of logic. He sets out from the basic principles of logic to achieve the following objectives :

- (i) the examination of the methods of analogy and induction.
- (ii) deduction by the rules and symbolism of formal logic in order to facilitate mathematical functions in the theory of probability.
- (iii) the development of probable knowledge.
- (iv) the creation of a sound basis for the growth of statistical inference.

Keynes' ideas on the philosophy of science, and on probability and induction opened up new avenues of thought and people expressed intellectual indebtedness to Keynes for his novel ideas in the realm of the logic of science. Thus, R.B. Braithwaite, a celebrated scientist, dedicated his work, *Scientific Explanation*, to the memory of J.M. Keynes.

Uniformities, Generalisation and Laws

Uniformity speaks of order. There is uniformity in Nature. Laws in science express uniformities. A Science aims at discovering laws and thereby uniformities.

Meaning of Uniformity

Uniformity may mean uniformity of causation. This meaning is hypothetical in form. If the same cause occurs, it will have the same effect. It is not said whether the same cause will occur or not. The second meaning of uniformity is : the course of Nature will be the same in future, as it was in the past. That is the unknown, will be like the known. But this interpretation is not based on scientific reasoning. We cannot say with certainty that since the sun has risen today, it will also rise tomorrow.

Paradox of Induction

The law of Uniformity of Nature is regarded as the formal ground of Induction. The truth of the principle of uniformity cannot be proved, but it must be pre-supposed. However, sometimes it is also believed that the principle of uniformity itself is an instance of induction. It is the result of induction by simple enumeration. The principle of uniformity is based on experience and induction, and is also the basis of induction. Thus, we face a paradox : The ground of induction is itself an induction.

Types of Uniformities

Uniformity of Co-existence : When certain properties or attributes exist side by side, then we say that there is the uniformity of co-existence. For instance, "All crows are black", "Water is colourless" etc. Here, certain properties are regularly found together. The laws which express such uniformities are known as Laws of Co-existence. Class name indicates that a certain uniformity of co-existence has been found. For instance, if certain specified properties e.g. absence of colour, are found in a liquid, it may be called water; otherwise not. The class-name is given on the basis

that certain attributes or properties are found to co-exist in that thing. And, in this way, an order among things is discovered.

Uniformity of Sequence or Succession : This involves order in time and causation. Here, one thing follows another. One thing may come before—antecedent, and the other thing may come after—consequent. In co-existence, the properties or attributes exist side by side at the same time. But in succession, one thing comes after another. For instance, lightning is followed by thunder. Through this type of uniformity we can find causal order or order of sequence of events. Cause-effect relationship is expressed by the uniformity of sequence.

Uniformity of Equality or Inequality : (Uniformity of the Mathematical Equation) : This uniformity is the basis of Mathematics. In mathematical equations, we find a certain type of uniformity i.e. a particular constant relationship which is quantitative. On the basis of such relationship, the causal laws can be replaced by mathematical functions. Here, the discovered order is the order of a quantitative relationship. For instance, Ohm's law regarding electricity states that the current is equal to the potential difference divided by the resistance.

However, Carveth Read has pointed out some more fundamental uniformities :

- (i) *The Principle of Contradiction and Excluded Middle.*
- (ii) *Some Axioms of Mediate Evidence, e.g., Aristotle's "dictum de omni et nullo".*
- (iii) *Uniformity of Time and Space.* It says that it is possible to definitely measure all spaces and times.
- (iv) *The Persistence of Matter and Energy.* It is stated that in all changes in the universe, the quantities of matter and energy remain the same.
- (v) *Law of Causation.*

However, it must be noted that induction deals with all these uniformities, but practically, the law of causation remains most important.

Generalisation

A science aims at generalisation or inference of a general proposition on the basis of observation of particular instances. The generalisation is made possible by the employment of experimental method which helps us in establishing a causal connection between things.

Basis of Generalisation

A science is concerned with the generality of things. It wants

to find out the truth, not regarding a single object or individual, but regarding the classes of objects or events. When the truth is discovered in a science, it is expressed in the form of generalisation. A generalisation is a general proposition regarding classes, objects or events, or the existence of a definite relationship among certain types of events or objects or classes. A generalisation being a general proposition, is applicable to the entire class of objects or events and, of course, the individual cases are included in the class to which they belong. The basis of scientific generalisation is the assumption of order in Nature. Order in Nature means the existence of uniformities in the characteristics of objects or events, or it may mean the regularity in the happenings of certain events.

There are various types of order in Nature, e.g., invariable association of properties, causal order, mathematical relationship and systematisation (for details regarding the types of order in Nature, see the chapter on *The Meaning and Nature of Science*).
Nature of Scientific Generalisation

The discovery of the order in Nature finds expression in the form of generalisation in a science. A scientist gives a general explanation of the objects, events or phenomena observed. The ultimate task of a scientist is to generalise.

The result or the end-product of a scientific investigation is the generalisation. Any scientific knowledge ends in generalisation. Generalisation indicates the completion of a scientific investigation for the time being. When new facts or new knowledge is gathered, the investigation may be continued further. And as a result of the new investigation, the old generalisation may be modified or even given up. Thus, no generalisation in science is once-for-all generalisation.

Generalisations may be taken as the media of collecting fresh and new knowledge about different phenomena. Generalisation itself helps to bring new facts and new knowledge. The present generalisation may become the basis of future investigation into facts and circumstances, and therefore, it may be the basis of future generalisation.

Scientific generalisations, however, speak of the tendencies or uniformities. They are neither certain nor permanent. Scientific generalisation is, more often than not, based on induction i.e. on the process of arriving at unknown facts from known facts. Such a jump leads to uncertain results. In making a generalisation, all the unknown cases are not observed and studied. Thus, generalisation is only probable or approximate. Scientific generalisations are uncertain, provisional or tentative propositions. These generalisations are not permanent but temporary in nature, because whenever new knowledge or new facts are collected, the old generalisations may have to be modified. However, there are invariable

generalisations which are universally true, so far as experience goes, e.g., "All material bodies fall to the earth". The generalisation is invariable because the relation between the subject and the predicate is regarded as universal.

Approximate or probable generalisations are useful where universal proposition cannot be found. Such generalisations may be made useful in a science with the help of statistics. For instance, if it is found that 90 per cent of the vaccinated persons are not attacked by small-pox at the time of epidemic, it may be inferred that vaccination prevents small-pox.

Types of Generalisation

There are two broad categories of scientific generalisation:

Empirical Generalisation : This type of generalisation is based on empirical observation or experience. The main task of this generalisation is to describe the phenomena as experienced or observed by the scientist in the process of investigation. It describes the regularities of occurrence or the observed uniformities of events. This generalisation does not say as to why the situation has happened, but it simply describes the situation. For instance, by collecting data, an investigator can say by how much percentage the population has increased during the plan period, but he does not say, in this type of generalisation, the causes of population growth. Empirical generalisation is the basis of further investigation into the causes of the phenomenon observed by the scientist. This type of generalisation characterises the early stage of a science; and becomes the basis for the formulation of possible hypothesis regarding the phenomenon.

Explanatory Generalisation : This type of generalisation provides the explanation for the tendencies, regularities or uniformities observed by the scientist. It explains the cause of the phenomenon. After analysing facts properly, this type of generalisation is arrived at. This generalisation is the end-product of a scientific investigation. It is the next step to empirical generalisation; and it occupies a higher place in a scientific investigation. This is so, because a science is, after all, a systematic body of explanation.

Laws

The word 'law' has various meanings. It may mean a command of a superior authority, or a mere uniformity, or a standard or ideal. In a science, law refers to an expression of some order in Nature.

Classification of Laws

Laws are broadly classified into three categories :

1. **Axioms** : Axioms are real, universal and self-evident

propositions. Axioms are self-evident. They do not require any proof, nor are they capable of any proof.

2. *Primary or Ultimate Laws* : They are less general than axioms but they represent the highest point reached by sciences. These laws are subject to proof. The Law of Gravitation is a primary law.

3. *Secondary Laws* : Secondary laws are generally derived from primary laws. They are either derivative or empirical. They are less general than primary laws. The three laws of Kepler are secondary laws because these are derived from the Law of Gravitation. Invariable or approximate generalisations are secondary laws. Carveth Read divides secondary laws into : (i) Laws of Succession and (ii) Laws of Co-existence.

Laws of Nature

The entire world is a system of laws. There are different laws that govern the different phenomena of Nature. There are definite laws of Nature, and these laws are connected to one another, and further into a system. Nature reveals uniformity and unity. This means that there are uniform relations existing between various phenomena of Nature. Law of Nature simply implies the uniformity of Nature. Laws of Nature are also called laws by analogy. Laws of Nature cannot be altered, modified or violated. It is positive, because it explains how natural phenomena actually behave. The Nature's laws are not imposed by any superior authority. Moral laws are normative i.e. they say "how it should be", but natural laws do not say so, rather they explain "how actually it is". A natural law, i.e. a law of science, is "nothing more than a regularity of uniformity in the character or relation of certain classes of facts or events" (Wolf).

Empirical Generalisation and Law of Nature

Empirical generalisations are based on observed facts. Therefore, in a sense, scientific laws are empirical generalisations. 'Law of Nature' implies a certain order or uniformity in the phenomena of Nature. It is the business of a science to discover the uniformity or order in Nature. The laws of science express laws of Nature. But scientific laws are empirical generalisations. Thus, Laws of Nature, in a way, are empirical generalisations.

However, the Laws of Nature are not merely empirical generalisations—they are something more. A science not only describes but also explains. Empirical generalisation in the ordinary sense is only a description of instances. When generalisation is explanatory with regard to the involved instances, it can be called a scientific law or a Law of Nature. When the empirical generalisation can be deduced from a more comprehensive generalisation or law, then it can be called the Law of Nature. For instance, the

generalisation that "All men are mortal" is based on the empirical cases of men dying. But this generalisation can also be deduced from the more comprehensive law which says that "All living beings are mortal". Thus, our former empirical generalisation that "All men are mortal" becomes a law of Nature. A scientific theory is, therefore, a deduced system. Prof. Braithwaite observes that if we are to consider whether or not a true scientific hypothesis would be a Law of Nature, we are to consider the way in which it could enter into an established scientific deductive system.¹

Nature of Laws of Social Sciences

The laws of social sciences, like the law of physical sciences, express uniformities. But the nature of uniformities expressed by the laws of social sciences is different from the nature of uniformities expressed by the laws of physical sciences. The laws of social sciences do not express exact uniformities; they simply express a tendency or a statistical average. Such laws cannot be falsified by a single negative instance. The laws of physical sciences express exact uniformities, and a single negative instance is enough to falsify a law of a physical science.

In a social science like Economics, laws or generalisations are the statements of tendencies. There are no tendencies in a social science, which act steadily and can be measured as exactly as Gravitation can be. The laws of social sciences are to be compared with the laws of the tides, rather than with the simple and exact Law of Gravitation. Since in social sciences human actions are involved, which are bound to be varied and uncertain, the statement of tendencies is necessarily inexact and faulty. Laws of social sciences are hypothetical in nature. For instance, economics studies the effects which will be produced by certain causes, not absolutely, but subject to the condition that other things remain equal. Laws of social sciences do not have the power of prediction. There are always some socio-institutional and political environments in which the laws of social sciences operate in a particular way. Generalisations of social sciences are essentially historico-relative in character, and their validity is limited to only certain historical conditions. Lack of exactness, and inadequate predictability of a social science make its laws imperfect and limitedly applicable.

Scaling Techniques

Definition

In social research, it is very essential to make distinctions of degree rather than of quality. The technique for registering difference in degree may be of two types. Firstly, one can make a judgement about some characteristic of an individual and, place him on a scale which is meant for measuring that characteristic. A scale is a continuum from highest to lowest points, and has intermediate points in-between these two extremes. The scale-points are so related that the first point indicates a higher position than the second point. The second point is higher than the third point and so on. Secondly, the technique may consist of questionnaires prepared in such a fashion that the score of individual's responses gives him a particular place on the scale.

A scale is a method of measurement. In social research, attitude, behaviour and other qualitative characteristics are measured by means of different scales. The scalability of a phenomenon depends on its continuum. The various factors of the phenomenon must be logically interrelated and should be capable of continued measurement. A scale must be reliable. The following methods can be used to test the reliability of a scale:

Reliability of Scale

(i) *Retest Method.* According to this method, the same scale is applied twice to the same population for the same objectives, and if the two results are similar, the scale is regarded as reliable. For this matter, the test can be done on two similar groups also.

(ii) *Multiple Form.* According to this technique, two types of scales are constructed, and they are applied to the same population. In case the two results are more or less similar, the scales may be regarded as reliable.

(iii) *Split-Half Method.* In this method the scale may be divided into two equal parts. Then each part is taken as a whole (i.e. as a

complete scale) and measurement is made separately. The correlation between the two scores obtained in this way is estimated, and if the degree of correlation is high, the scale may be regarded as reliable. In a scale, proper weightage should be given to the various points, provided the various items are disproportionate or unequal. However, a scale must be valid, i.e. it should correctly measure things.

Validity of Scale

There are at least four different criteria for measuring validity:

(a) *Logical Validity*: The scale must conform to commonsense reasoning, and therefore, is partly subjective. But still, in some very clear cases, this crude method may be helpful.

(b) *Known Groups*. In this method, the scale is applied to the known category of people. Then, the result obtained is compared with the known facts. If they are similar, the scale is considered to be valid.

(c) *Opinion of Jury*. This method depends on the considered opinion of many jurists who will have no bias. If several jurists give the same opinion, the method of measurement may be considered as valid.

(d) *Independent Methods*. A thing may be separately measured by separate independent criteria, and if the results are similar, the scale may be said to be valid. However, these methods of testing the validity of a scale are not free from flaws. Thus, they have to be used very cautiously.

The scaling method is used when the researcher wishes to utilise simultaneously a number of observations on a respondent. A number of difficulties may be encountered by the researcher in arranging the meaningful responses logically and in incorporating the responses in the analysis of attitude. Reasonable reliability is one attribute required for a scale, validity is another; but they are related matters. It is very difficult to objectively interpret validity. While the commonsense approach gives "face validity", a good judgement may ensure "content validity."¹ Where a scale is developed on the basis of objective criteria, the validity can be judged by testing the criteria itself. The validity may be for the future (predictive validity) or for the present (concurrent validity).

Difficulties in Scaling

1. The difficulty of applying rigorous and objective tests in attitude measurement arises from the fact that such measurement is

1. Moser and Kalton, *Survey Methods in Social Investigation*, Heinemann Educational Books Ltd., 1971, London, pp. 355-56.

indirect, for attitude is inferred from verbal responses. An attitude is an abstraction, and as such, it is almost impossible to assess its validity directly.

2. A scale is applicable to a particular group or class. It is not universally applicable. Human behaviour is heterogeneous and unpredictable.

3. Social phenomena are complex and qualitative in nature. The concepts themselves are not defined properly. Thus quantitative measurement is a baffling affair.

4. There is no universally valid or recognised measuring rod. The measuring unit itself may be variable. A valid scale, in the ultimate analysis, is also a subjective consideration. But the most baffling problem is the criterion of validity.

5. Human behaviour is flexible and variable. Whatever attitude is expressed at a point of time may not be taken as reliable. Even a valid scale may not remain valid during the period of analysis. There is often a dichotomy between the expressed attitude and overt action.

6. The intangibility of social phenomena is an obstacle to scale construction. The scores of the scale cannot be correctly tested because of the intangibility of the social phenomena.

7. The social phenomena cannot be experimented in a controlled way. The phenomena may be individual, private or esoteric. Therefore, they cannot be properly watched and evaluated. Thus, scale cannot measure all the causative variables involved.

Despite these limitations, the scaling technique can be improved to measure the social phenomena more or less accurately. The sociometric type of analysis is a case in point.

Types of Scales

There are the following four main types of scale: nominal, ordinal, interval (cardinal) and ratio scale. They are discussed below :

Nominal Scale

A nominal scale consists of two or more named categories into which individuals, objects or responses are classified. In a nominal scale, it is possible to distinguish two or more categories relating to the specified attribute. The members of these categories differ with respect to the specified attribute which is being measured. It is a simple method of classification rather than an arrangement along a continuum. The question of dimension is not important in this type of scale. If desired, the different groups may be numbered.

Classification of individuals according to religion is an example of nominal scale.

Ordinal Scale²

In this type of scale, numbers, e.g. 1, 2, 3 ... etc. are assigned to indicate only the relative position. The scale purports to give ranks to the individual along the specified continuum. But such a scale, like the nominal scale does not measure the distance between the positions. In this scale, it is very essential to determine the order of position (in terms of more or less, better or worse and so on) in relation to the attribute which is being measured. For instance, X is regarded as more beautiful than Y. The ordinal scale can indicate only a person's relative position, but it cannot cardinally measure the differences between persons. One can say, for example, X is greater than Y; but he cannot say by how much.

Interval (Cardinal) Scale

This scale has equal units of measurement. Thus, it is possible to interpret not only the order of scale scores but also the distance between them. Thus, two persons with scale positions 4 and 5 are as far apart as two persons with scale positions 10 and 11. A person having the score of 10 cannot be regarded as two times higher or better than a person whose score is 5. When we talk of 10°C rise in temperature, it does not mean that it is twice as hot as 5°C. In an interval scale, the intervals remain equal.

Ratio Scale

This scale incorporates the properties of an interval scale together with a fixed origin or zero point. Weight, length and time are obvious examples. On the basis of a ratio scale, one can compare both differences in scores and the relative magnitude of scores. For instance, the difference between ten and fifteen minutes is the same as that between fifteen and twenty minutes, and ten minutes is twice as long as five minutes.

Rating Scales³

The rating, ranking and attitude scales have one common method of assigning numerical positions to individuals so that variations in degree may be ascertained. While preparing a rating scale, the rater places the individual at a particular point along a continuum, and a numerical value is attached to the point. The following are the main types of rating scale used in social research:

2. See also the chapter on *Measurement*.
3. Selltitz, Jahoda and Cook, *Research Methods in Social Relations*, Holt, Rinehart and Winston, New York, 1959, pp. 345-50.

(i) *Graphic Rating Scale* : This is the most commonly used rating scale. Under this method, the rater indicates his rating by putting a tick at the point selected by him on a line chosen for measuring an attribute and specifying points from lowest to highest. The different scale points may indicate brief descriptions about attitude levels. This may help the rater to indicate his own preference. The following is the example of a graphic rating scale :

Students' Participation in Educational Management

1	2	3	4	5
Feels strong for Students' Management	Generally Feels the necessity of participation	Partly favours Partly disfavours	Generally feels no necessity of participation	Strongly feels No Necessity of participation

The rater may mark any one of the five points to indicate his own rating, and thereby may reveal his preference. The graphic rating scale is a very simple and convenient device to use. It ensures a fair level of fineness of scoring. In this scaling, vague, unlikely and extreme statements should be avoided. Secondly, as far as possible, the descriptive statements should closely correspond to the numerical points on the scale.

(ii) *Itemised Rating Scale* : This is also known as the "specific category scale" or "numerical scale". In this scale, the rater has to select one of the limited number of categories that are in order in terms of their scale position. Generally, in such a scale, there are five or seven categories. Barker, Dembo and Lewin prepared a seven-point scale for rating constructiveness among children. As a general rule, the more clearly defined the categories, the more reliable becomes the ratings. The number of specifications, however, depends on the nature of the research problem.

(iii) *Comparative Rating Scale* : In the case of comparative rating scale, the positions on the rating scale are explicitly defined in terms of a given population or group, or in terms of people with known characteristics. Thus, the rater may be asked to specify the comparative ability of a teacher with reference to the teaching of a college or he may be asked to specify the comparative skill of a painter with reference to other painters, e.g. X, Y or Z. The comparative ability of the individual or the group in question may be expressed in percentage terms by the rater. For instance, Mr A is more competent than 10 per cent of the teachers. The rater must have a clear knowledge of the abilities of the given groups or individuals.

Precautions and Limitations for Rating Scales

(a) It is difficult and sometimes dangerous to fix up rating about many aspects of an individual (or overall aspect) from only one or two known qualities. There may be some "halo effect" in the judgement which should be carefully guarded against.

(b) The raters may overestimate the qualities of a known person, and underestimate those of unknown persons.

(c) The raters very often do not want to make extreme judgements.

(d) In the absence of objective standards or definitions, different raters may give judgement on the basis of subjective evaluation. Thus, the scale becomes unscientific and unreliable.

The raters themselves must be unbiased and trained. The specifications of the reference groups and the definitions of the attributes being measured must be objective and clear. In the case of judgement of complex attributes, it is better to use a less differentiated scale. Several raters giving independent judgement can work as a team, and can be very helpful in increasing the reliability of ratings, particularly when these are made during the process of analysis by coders. However, the rating scales are very simple and useful to apply irrespective of the method of data collection.

Rank Order Scales

Rank order scale is another method of comparative and relative rating. In this method, the judge is required to rank individuals in relation to one another. When the population is very limited, the judge has to prepare a rank order of individuals from highest in the scale to the lowest. In a rating scale, the individual rater himself may be the subject of rating. This is known as self-rating. Self-rating has its own advantages and limitations. However, self-rating has been found to be useful in measuring the attitudes like intensity, importance, liking and so on. The following two methods may be illustrative.

(i) *Paired Comparison* : This is a simple method of ranking scale. In this type of scale, two stimuli are presented before the judges, out of which the better one is to be selected. The continuum is properly defined. The ranks for different types of jobs, for instance, suitable for ladies, can be determined. The investigator can make several pairs of jobs available. The respondent may be asked to point out which of the two jobs he/she likes. After all the pairs have been considered, any possible inconsistency may be located. For instance, if job 2 is preferred to job 3, and job 3 is preferred to job 4, then by the transitivity axiom, job 2 is preferred to job 4. If somebody prefers in this connection job 4 to job 3, his behaviour is inconsistent and, the inconsistent result may be eliminated. In this method, the

number of preferences of all persons for a particular job is added and is divided by the number of people who are giving the preferences. The result that is obtained becomes the scale value for that particular job. On this basis, score values are ascertained. The scale value is explained numerically.

Persons Preferring	Number of Preferences
A	6
B	5
C	5
D	4
E	3
F	1

The scale value = $24/6 = 4$

This method is only a rough and simple method. It can, however, be made more meaningful by constructing a paired comparison matrix, as has been done by Guilford in his *Psychometric Method*.⁴

(ii) *Horowitz Method*: Horowitz applied a ranking scale for testing racial prejudices. He took 8 pictures of negroes and 4 pictures of white children. These 12 pictures were shown to the school children who were asked to indicate their preferences. First preference was indicated by the number 1, second by 2, third by 3, and so on. Then, separately the scores for the whites and for the negroes were added, and compared. In this way, it was possible to know the attitudes towards negroes and whites. Needless to say, the smaller the score, the greater is the preference. If all the white children are given the first four preferences, the total score would be 10 ($=1+2+3+4$); but if they are given the last four preferences, the total score would be 42 ($=9+10+11+12$). So the possible range for the white children would be from 10 to 42. The probability of score value

would, therefore, be $\frac{10+42}{2} = 26$. If the actual score is less than 26, it

would be considered as a favourable attitude; and a score more than 26, would imply an unfavourable attitude.

The same photos can be used for choosing the companions for a variety of situations, case by case. If there are only 5 situations, the maximum number of White faces in all the five situations (say, for going to party, for play, for dancing, and so on) would be $5 \times 4 = 20$. Now, taking 20 as equal to 100, the percentage of actual

number can be calculated. Since the number of white faces was 4 out of 5, the probability of selection was 80 per cent. Any increase or decrease in the number may be in favour or against the case, depending on the direction of difference. Picture tests have been used by many investigators to find out the decisive factors governing individual preferences and attitudes.

Attitude Scales

In this type of scale, the attitude of an individual towards a matter, thing, object or system can be known from the score of his responses given on a questionnaire. The score will place him on a scale. He simply expresses his like or dislike, agreement or disagreement with the issue involved, as given in the forms of questions. On the basis of his reply, he is assigned a score which indicates his position. This type of technique is used in measuring the social attitudes.

In the attitude scale, some relevant statements are to be considered by the respondents. The statements are formed in such a way as to be intimately related to the attitude which is sought to be measured. Indirect statements may sometimes be used to reveal the attitude. Secondly, the scale should be able to specify the various but crucial shades of opinions. For instance, extreme, moderate and neutral attitudes must be expressed through the statements so that the respondents have several reasonable ways of expressing their attitudes. Thus, the method of scale formulation remains very decisive, and so is the method of scoring. Depending on the differences in these regards, there may be various types of attitudes scale. These are discussed below :

(i) *Point Scale* : In this scale, at first, a crucial number of words about which the opinion is required is selected. The words may be prayer, dancing, birth control, smoking, and so on. The respondent is to cross out every word that is more annoying than pleasing to him. One point is given to each agreement or disagreement, whichever is to be chosen. If agreement is to be considered, for instance, each word which has not been crossed will be given one point. According to this method, the attribute of a respondent is known by calculating the numbers of words crossed or not crossed. The words selected should be suggestive of an attitude and the opposite words should also be given at the same time. If a person crossed 'dancing' and left uncrossed "prayer", he could be a puritan.

Although the scale is very simple, it has some practical limitations. Firstly, it is very difficult to find an adequate number of words expressing the same attitude. Secondly, the attitudes of persons with neutral or confused opinions cannot be represented by this scale. The words may not be dichotomous in nature.

There is another variety of point scale. In such a scale two sets of words, indicating both favourable and unfavourable opinions, are

given. The unfavourable items may be crossed and favourable items may be left unscored. For instance, if a person scores out words favouring "capitalism", and leaves out those favouring "communism", he can be said to be a communist. One may not have complete aversion to or intimacy with a group or individual or race. There may be various degrees of intimacy or aversion. An attempt has been made by Bogardus to measure the degree of aversion or likings by his "Social Distance Scale".

(ii) *Differential (Thurstone) Scale* : This scale is associated with the name of L.L. Thurstone. Hence, this is also known as *Thurstone Scale*. In this scale a number of statements, whose position on the scale has been determined by judges, is used. The position is determined by the method of equal-appearing intervals. The procedure is as follows.

At first, a large number of statements relating to attitudes are collected by the researcher. A large number of judges work independently to classify these statements into eleven groups. In the first group, all the statements which are most unfavourable to the specified issue are placed. The next unfavourable statements are placed in the second group, and so on. The statements of the eleventh group are considered most favourable. The sixth position on this continuum is the point at which the attitude is neutral. The first group is given the score 1, and the eleventh group is given the score 11. The scale value of a statement is computed as the 'mean' or 'median' position to which it is assigned by the judges. Statements which are ambiguous, vague, irrelevant and over which judges differ widely are discarded. Finally, the scale is prepared by taking into account the evaluated statements that spread out evenly from one extreme to the other.

Thurstone scale consists, thus, of a series of statements whose positions have been determined neutrally by the judges. At the time of administration of the scale questionnaire, the respondents are asked to check the statement or statements with which they agree. The scale values are not shown in the questionnaire and the statements are arranged randomly. The mean or the median of the scale values of the items which are checked by respondent indicates his position in the scale. This type of scale has been widely used to measure attitudes towards various social phenomena. The scattered responses of an individual implies that the respondent has no definite and organised attitude towards the phenomenon. Thurstone scale is, however, most appropriate and reliable in the case of a single attitude which is sought to be measured. Several criticisms may be raised against this scale :

- (a) The scale values are influenced by the attitudes, intelligence and background of the judges. This fact has been found out

by the studies made by Kelley, and Hovland and Sheriff, among others.

- (b) The method of constructing this scale is complicated. There are large numbers of statements, large numbers of judges, and a large variety of attitudes out of which proper selection has to be made. It is also necessary to find out the most reliable statements to form a continuum.
- (c) Different individuals may have the same score on the basis of 'mean' or median, but still their attitudes may not be similar.

Despite these criticisms, the Thurstone-type scale constitutes a reasonably satisfactory ordinal scale.

(iii) *Summated (Likert) Scale* : This type of scale frequently used in the measurement of social attitude was first devised by Likert. Hence, it is also known as Likert-type scale. Unlike the differential scale, the Likert scale uses only the definitely favourable and unfavourable statements. Likert scale excludes the intermediate opinions. This scale consists of a series of statements to which the respondent is to react. The respondent indicates the degree of agreement or disagreement. Each response is given a numerical score, and the total score of a respondent is found out by 'summing up his different scores for different responses. This total score indicates his position on the continuum.

The Likert scale uses several degrees of agreement or disagreement, e.g., strongly approve, approve, undecided, disapprove, strongly disapprove. These five points will constitute the scale. Each point of the scale carries a score "strongly approve" is given the highest score (5 or +2) and "strongly disapprove" is given the least score (1 or -2). Other points will have the scores accordingly (i.e. 5, 4, 3, 2 and 1). The score values are not indicated in the questionnaire. The following is a Likert-type scale.

Statement 1 : Prohibition should be made compulsory

1	2	3	4	5
Strongly Approve (5 or +2)	Approve (4 or +1)	Undecided (3 or 0)	Disapprove (2 or -1)	Strongly Disapprove (1 or -2)

The following is the method of construction of a Likert-type scale :

- (i) The researcher gathers a large number of statements which clearly indicate favourable or unfavourable attitude towards the issue in question.

(ii) The questionnaires consisting of the above five points with respect to a statement are administered to the respondents who indicate their responses.

(iii) The responses will imply various scores as shown above. The scores are consistently arranged either from the highest to the lowest, or from the lowest to the highest.

(iv) By adding up the different scores of an individual, his total score is calculated (i.e. summation of different scores for different statements).

(v) The researcher should identify the items which have a high discriminatory power. The responses are interpreted to determine which of the statements discriminate very clearly between high scores and low scores on the total scale. It has to be ensured that the questionnaire is consistent. To achieve this, the items with low discriminatory power or those having no significant correlation with the total score are eliminated. The main idea is to ensure that every item or statement is related to the attitude which is under study.

The Likert-type scale has the following main advantages over the Thurstone scale :

(a) The method of construction of Likert type scale is less cumbersome.

(b) It supplies more precise and definite response towards an issue. The intermediate vague points are absent in this scale.

(c) The Likert scale permits the revelation of several (five) degrees of agreement or disagreement; but Thurstone scale is based on only two alternative responses i.e. acceptance or rejection. Thus, Likert-type scale is more informative and reliable than the Thurstone scale.

(d) In a Likert-type scale, any item or statement empirically consistent with the statement may be included. In Thurstone scale, only the strictly related items are included. Thus, Likert-type scale has a broader area of reference and has also a method of checking internal consistency which is conspicuous by its absence in Thurstone scale.

However, the Likert-type scale is not free from defects. The judgement on the basis of total score, which is estimated by calculating the mean or median, is not scientific. The total score values may be the same in many cases, but the attitudes may be different towards an issue. The scores on the Likert-type scale may be helpful for making an ordering of the people, but such an ordering will not have any scientific and objective basis. Another defect of the scale is that there is no objective basis for expressing different degrees of agreement or disagreement. However, despite some limitations, it remains an important ordinal scale.

(iv) *Cumulative (Bogardus) Scale* : In the cumulative scale, a respondent is given a number of questions, to express his agreement or disagreement over an issue. The items are arranged in such a way that a respondent who responds favourably to item number 2 also replies favourably to item number 1 and one who replies favourably to item 3 also replies favourably to items 1 and 2, and so on. Therefore, the individuals who answer favourably have higher total score than those who answer unfavourably. The score of an individual is computed by counting the number of items he answers favourably. His scores indicate for him a particular position on the scale. The intervals between the positions may not be equal. The items may be arranged from favourableness to unfavourableness in a systematic manner or may be randomly selected.

The cumulative type of scale was successfully used by Bogardus first. Thus, it is also known as Bogardus' social distance scale. The main purpose of social distance scale is to measure the attitude towards a particular racial group or groups. A number of suggested relationships may be listed, to which members of an ethnic group may be admitted. The respondent is to indicate as to which racial group is to be admitted by him for each of the specified relationships. The attitude is measured by the closeness of relationship that a respondent is willing to accept or the social distance that he likes to maintain. The Bogardus-type scale is given below :

Relationship I would accept	English	Negro	French	Chinese
1. Marriage	1	1	1	1
2. Friendship	2	2	2	2
3. Neighbour	3	3	3	3
4. Employment in same occupation	4	4	4	4
5. Citizenship in my country	5	5	5	5
6. Visitors to my country	6	6	6	6
7. Exclusion from my country	7	7	7	7

The respondent is to circle each of the seven categories to which he is willing to accept a particular group. The respondent's first feeling reactions can be known by this. For a group, if a respondent circles 3, he is also expected to circle 4 and 5 for the same group. If a respondent does not circle 3, he will most probably not circle 1 and 2, for these indicate even closer relationship (for the same group). The seven categories indicate a gradually increasing social distance.

The fact that the specified items in Bogardus scale form a cumulative scale is empirically borne out in many countries. However, some

Category	Weight	English		Negro		French		Chinese	
		% Response	Weights × %	% Response	Weights × %	% Response	Weights × %	% Response	Weights × %
1	1	90	90	45	45	10	10	5	5
2	2	94	188	50	100	20	40	10	20
3	3	95	285	60	180	30	90	15	45
4	4	96	384	70	280	40	160	20	80
5	5	97	485	80	400	50	250	25	125
Total			2332		1005		550		275

practical reversals may be noticed on the social distance scale. For instance, a group may not be liked as neighbour, but may be liked as friend in a club. But these reversals are more possible in individual cases rather than for the group as a whole. The reversals have been found to be mostly due to the influences of external factors.

In the Bogardus-type scale, the respondent has to indicate his first feeling. He has to give his reaction to each race as a group, and he should not take into account any individual member of a group, best or worst, into account. The social distance can also be calculated mathematically. In order to do this, weights are attached to different categories of relationships. Thus, if there are only five categories, the weights such as 1, 2, 3, 4 and 5 can be assigned to the first five categories respectively. The following procedure is generally adopted for the measurement of social distance :

- (i) Place the weights and percentage response for each category in rows.
- (ii) Multiply the percentage response by its weight.
- (iii) Add up the product, and this will be the social distance (see the following chart).

In the Bogardus-type scale, the score does not indicate the exact extent or degree of preference of a group over the other. This is, of course, the implicit idea of any ordinal scale, as we have stated elsewhere. One important difficulty in this type of scale is that one may not be fully acquainted with a group and hence it is not possible for him to state the attitude. The influence of an individual member or members may not be eliminated from the mind while making preferences.

With the development of the Thurstone and Likert scaling methods, attention has been shifted away from cumulative scaling towards unidimensional scaling which seeks to avoid the influence of the external factors. In fact, doubts have been raised by Carter and others regarding the basis of continuum scale as given by Thurstone-type scale. Different statements, for example, regarding war in a Thurstone-type scale do not fall along a straight line. For instance, "war is good", "war is bad" and "I do not think about war"—these statements cannot make one continuum or a straight line scale. When one is combining different and contradictory statements about an issue, it is impossible to specify as to what is exactly being measured. This reaction has given rise to the development of various scaling techniques and the Guttman scale is one such attempt in this direction.

(v) *Scalogram (Guttman) Method* : The Guttman scale is based on the assumption that the various attitude statements in the scale belong to the same dimension. The attainment of a high degree of unidimensionality is the major concern of the Guttman scale. However the Guttman scale belongs to the broad category of cumulative scaling. According to Guttman, a "universe of content" can be considered to be unidimensional only if it yields a perfect, or nearly

perfect cumulative scale. That is, whether it is possible to arrange the responses into a pattern of the following type :

Scalogram

Score	Says "Yes" to item			Says "No" to item		
	3	2	1	3	2	1
3	×	×	×			
2		×	×	×		
1			×	×	×	
0				×	×	×

If the above pattern holds, then a given score on a particular series of items always has the same meaning. A score enables one to say as to which item is endorsed by the respondent. For instance, a man having a score of 2 will say 'yes' to statement 2 and 1, but will say 'no' to statement number 3. In this way, some uniformity may be achieved. The scalogram technique is based on "reproducibility criterion" i.e. it is possible to reproduce the responses of the respondent about each item from the score item. This is a major test of the Guttman scale (see chart above).

A perfectly cumulative or unidimensional scale is hardly possible in social research. Scalogram analysis is a simple method of testing the "scalability" of the statements. The views of judges are not necessary in this case. A diagram in which individual responses are laid out is called a scalogram. In the Guttman technique, the perfect scale implies that a person who answers a given question favourably will have a higher total score than a person who answers it unfavourably. The Guttman scale is analytically complex, apart from the fact that there is no guarantee that the various items will scale, and even if they do, the universe of content may remain narrow in coverage. This method is more appropriate for scaling ordered behaviour than less structured and broad-based attitudes.

Guttman model is deterministic in nature. It assumes that a person who responds positively/negatively to one item, must respond positively/negatively to a series of others. The model can be made probabilistic rather than deterministic. This attempt has been made by "Latent Structure Analysis", as developed by Lazarsfeld.

Guttman has developed another technique. According to this, the respondent not only gives his view (agreement or disagreement) but he also mentions the intensity (degree) which is classified into five categories. For each respondent, we thus get two scores (content score and intensity score) which can be plotted against each other on a graph. The result often gives a U-shaped curve. The more extreme views have highest intensity. The content score at the lowest point of the curve may be regarded as the dividing line between favourable and unfavourable responses. The lowest point suggesting favourable

response is not affected by the form and the wording of the individual items. Hence, this method is objective.

Edwards and Kilpatrick have suggested a method of selecting a set of statements likely to form the unidimensional scale. It is said that Guttman scale virtually offers no guidance for selecting the items that are likely to form a scale. Edwards and Kilpatrick's *Scale Discrimination Technique* combines the Thurstone and Likert approaches. The items selected are those which have the highest discriminatory coefficients in their scale intervals.

It has to be noted that unidimensional scale has, at least, the following two limitations: (i) A unidimensional scale may not be the most effective basis either for measuring attitudes towards, or for making predictions about, the behaviour relating to such objects.

(ii) A given scale may be unidimensional for one group, but it may not be so for the other. A study made by Harding and Hogrefe demonstrated empirically that a signal scale did not effectively function as a unidimensional scale on the different categories of labourers.

Some Recent Modifications of Scaling Techniques

We shall, in particular, describe two recent approaches: The Q-sort and the Semantic Differential.

The Q-Sort: The basic operations of the Q-sort method are similar to those of the Thurstone scale. But the objectives of sorting are different. In the Q-sort, the purpose of sorting is to get the individual's own view or attitude towards the object under consideration. The criterion for placing statements in different groups is the extent of the agreement of the individual. The pattern of his sorting of statements gives the data for the analysis of his position. In the Q-sort, the number of cards to be placed in a group is specified so that the sort forms a normal distribution.

The method is widely applied in the study of personality. The individual can make a study of changes in his own image, or in his ideal person and so on. Some authors have held the view that factor analysis is essential for this technique, but others have rejected this view. Various types of relations can be estimated for the study. The data yielded by the Q-sort can be summarised into a single score, as in a summated scale, to yield a score on "adjustment". The adjustment score of the control group can be compared with the therapists' ratings of the success of therapy, and the extent of agreement can be known. The technique can also be applied to the study of various types of socio-economic attitudes.

Semantic Differential: The semantic differential technique was developed by Osgood, Suci and Tannenbaum. Its main objective is to examine the meaning of certain concepts, e.g., church, wife, socialism and so on. In a sense, it is an attitude scale. The groups of

subjects may be asked to rate a given concept on a series of seven-point bipolar rating scales. Generally, a seven-point scale is utilised, whose two ends will use adjectives which are opposite, e.g., good-bad, kind-cruel and so on. Subjects are asked to go through a set of scales for a particular concept and to place a check-mark in one of the spaces on each scale to indicate their ratings of the concept's position with respect to the adjectives involved. The positions are then assigned scores 1 to 7. Osgood and others have investigated the correlations between the scores given to a set concept on different bipolar scales by conducting a series of factor analysis. The three main factors are the individual's *evaluation* of the concept, power of the object or *potency*, and the individual's perception of the activity of the object or concept.

The semantic differential makes the measurement and comparison of various objects or concepts possible. In order to form an attitude scale, what is required is to decide the description of the issue to be evaluated, and to choose suitable adjective pairs for it. A respondent's total score is the measure of his attitude. It is like a Likert-type summated rating scale. However, in a semantical differential there is only one issue to evaluate. Osgood and others have found high correlations between semantic differential and Thurstone scale scores, and between semantic differential and Guttman scale scores. These correlations imply that semantic differential can be an important attitude scaling. In the formulation of scaling technique, 'concept' becomes very crucial. A rating scale meant for consistent measurement cannot be developed independent of the concepts being examined.

Concluding Remarks

Attitude scaling is essentially a very vast area of research which is in constant flux. We have only outlined very simply some of the existing methods. A researcher should first try to employ one of the existing scales in his enquiry. But the scale must be appropriate to his population and the subject he is studying. This may save his time and energy. But given ingenuity, a researcher may develop useful measuring technique and contribute to the existing stock of knowledge in this area.

APPENDIX

SOCIOMETRIC METHOD (SOCIOMETRY)

Meaning and Nature

Sociometry deals with social relations among groups and individuals. Sociometry is a "method for discovering, describing, and evaluating social status, structure and development through measuring the extent of acceptance or rejection between individuals in groups."¹ Another definition states that sociometry is "a method used for the discovery and manipulation of social configurations by measuring the attractions and repulsions between individuals in a group."² Sociometry is concerned with the measurement of social distance and also the institutional behaviour. Helen Jennings has defined sociometry as "means of presenting simply and graphically the entire structure of relations existing at a given time among members of a given group."³ A graphic representation of social relations reveals immediately the main social communications and the whole range of attractions and repulsions among the members of the group. It pinpoints the communication channels in the social system.

J.L. Moreno in his book, *Who shall Survive?* (1934) outlined first the concept of sociometry which was discussed in detail in the revised version of the book in 1953. Sociometric method has been extensively used in the study of group structure, personality traits and social status. It involves a set of operations fundamentally different from the method applied by Bogardus in the measurement of social distance. Sociometry is able to explicitly and precisely explain the configurations of group relations, the features and composition of cliques and other sub-systems, social position of individuals and points and directions of influence, both intra-groups and inter-groups. The utility of the method as a tool of analysis has been adequately demonstrated by many empirical studies in different areas of social research.

Sociometry is fundamentally concerned with the social interactions among social groups.⁴ The interaction may be of any type. The grist for sociometric analysis may be provided by questionnaires.

1. U. Bronfenbrenner, "A Constant Frame of Reference for Sociometric Research" *Sociometry*, VI, pp. 363-372.
2. J.G. Franz, "Survey of Sociometric Technique with an Annotated Bibliography" *Sociometry* II, pp. 76-90.
3. H.H. Jennings, *Sociometry in Group Relations*, American Council on Education, 1959.
4. C. Seltiz, *et al.*, *Research Methods in Social Relations*, Holt, Rinehart and Winston, 1959, pp. 268-271.

observation and other records of data. The idea is to fish out information as to the preferences of different members with respect to the selection of companions for different activities. Sociometric method can provide useful data/information about the position of an individual in the group in relation to other groups and sub-groups. Different sociometric studies have been conducted with respect to the problems and processes of leadership, race relations, friendship social adjustment and so on.

Sociometric Measurement

Sociometry is based on the principle of "sociometric test". Moreno first applied "sociometric test" in his empirical study regarding the groupings in public school in U.S.A. In this test, every member of a group may be asked to select a specified number of people from within the group, who could be made his friend, leader and colleague, and so on. Selection and rejection are based on some specific criteria. In the sociometric test, it is necessary firstly, to ascertain the fundamental criteria around which group activity takes place. Secondly, it is also necessary to test the pattern of attraction and repulsion in terms of these criteria.

Personal interviews may augment the results of the sociometric test. This method was adopted by Moreno in his study of State Training School for Girls at Hudson, New York. In order to determine the girl's position in the social structure, Moreno also investigated through interview the motivation for attraction and rejection. Sociometric technique has to be carefully used in every situation and has to be used with discrimination. As in other scaling techniques, sociometry faces difficulty in procuring reliable information for sociometric tests.

The type of interaction within a group depends on the nature and function of the group. The interaction and behaviour of the members can be known by conducting an observation by the researcher. If we want to know, for instance, the relationship among 10 teachers in a university department, we may attempt a sociometric measurement which can reveal the degree of attraction and rejection among the teaching staff. The procedure is as follows:

A university department wants to send three of the most popular teachers to a conference. Every teacher may now be asked to select three colleagues in order of preference, e.g., 1, 2, 3, the first preference being 1, second 2, and third 3. There are as many choosers as the number from which the choice is to be made. In other words, all the 10 teachers will have to make the choice (three candidates by each teacher). When the choices are finalised, the data can be arranged either in the form of a matrix table or in the form of sociogram which itself can be prepared from the matrix table ($N \times N$ table). Since, in our example, we have 10 choosers, the table will be a 10×10 table, as the following:

CHOSEN

CHOOSERS

	A	B	C	D	E	F	G	H	I	J
A		2	1						3	
B	3		2				I			
C	3			I		2				
D			1		2			3		
E			2	3				1		
F			1				3	2		
G				1		2			3	
H			1			2	3			
I	3	2					1			
J			2				3		1	
Preferences I	—	—	4	2	—	—	2	1	1	
II	—	2	3	—	1	3		1	—	
III	3	—	—	1	—	—	3	1	2	
Total	3	2	7	3	1	3	5	3	3	0

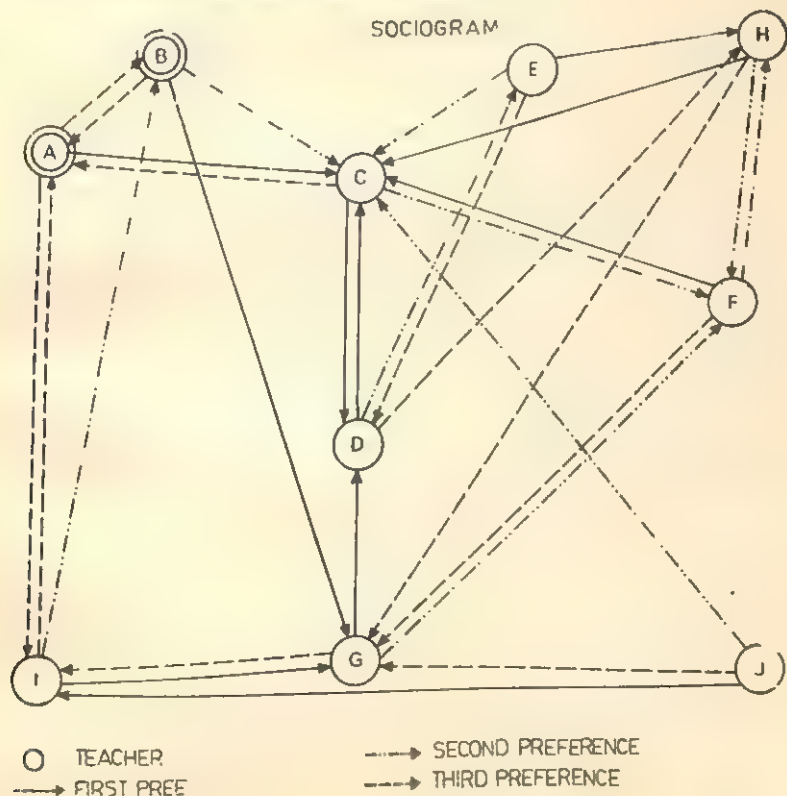
(SOCIOMATRIX)

In the above table, the various numbers in various cells indicate the preferences. As in the table, there are various types of relationship among the 10 teachers in the university department. These relationships are called mutual relationship, triangular or quadrangular relationship, clique, star and so on. Let us explain them.

In the case of *mutual choice*, two persons reveal preference for each other, as in the case of A and B, and C and D (see the Table). The order of preference may be either the same or different. When two persons are not connected directly but indirectly through a via media, the relationship becomes *triangular*. Our table shows triangular relationship among A, B and C. C has chosen A, and A has chosen B. In this way, B and C are mutually connected through a triangle. A relationship between two persons through four different links is called *quadrangular* relationship. The direct link is, however,

stronger and more real than the indirect links. In a *clique*, three or more persons have mutual relationship with one another. This relationship is direct. In the case of *star* relationship, the concerned person is chosen by most of the people. They are so popular that they can be the leader of the group. In our table, C is the "choice star", for he gets the maximum number of choice (7). However, popularity can also be enjoyed indirectly. In our table, D has received only 3 choices directly, but he has been chosen by C and G who are themselves the two very popular stars. Thus, D can be powerful and very popular through indirect ways. The popularity of D is based on the *secondary choice*. Such a person is also known as an *Aristotle-leader*. The person who is not chosen by any one is known as *totally isolated*. Our table reveals that "J" is a totally isolated person. Such a person does not have any significant place in society, and can create problems for society as well as for himself.

Thus, the sociometric matrix reveals quite clearly and interestingly the inter-personal relations among the teaching staff in a university department. The same data and relations, as shown by the graph, can be presented in the form of a *Sociogram*.



As the sociogram reveals, C is highest number of choices (7), and out of these four are first preference choices and three second preference choices. C is, both quantitatively and qualitatively, the most popular teacher. The above sociogram represents a pattern of choice of teachers for a conference. If we had a group considerably larger than what is given here (i.e. 10), we might have got a *clique* type relation. Anyway, the choice pattern may also be known with reference to other criteria. The criterion must be clearly known by the members of the group. The criterion should be realistic as well. It is necessary to maintain a fair degree of consistency between the sociometric structure and the criteria on the basis of which choice is sought.

The matrix method is especially valuable in mathematical analysis and synthesis. According to Stuart Dodd, the matrix has the following advantages: (1) the relationship between every single pair is specifically recorded (2) joint relationships between pairs can also be recorded (3) only one interrelation (criterion) is recorded on each matrix and can, thus, be isolated for scientific study, and (4) matrices may be combined and compared. However, according to P.V. Young, as a graphic device the matrix is inferior to the sociogram; it is also inferior as a tool of analysis for explaining various aspects and types of group behaviour and structure. Moreno observes that the sociogram and the sociomatrix supplement each other. Both the methods should be used in research work, and a synthesis between the two seems to be possible.

The questionnaires and interviews, as already pointed out, are the two main instruments required for administering sociometric tests. These are easy to administer and are suitable for different situations. The choosers may give the names of all persons they like in order of preference. Moreno himself recommended that the respondents should be permitted to indicate the total range of choices or rejections without any formal limitation. Such a method would provide a sensitive and objective picture regarding interpersonal relations. But when the group is very large, the respondents should be given to indicate only a limited number of preferences. This is more pragmatic.

Construction of Sociometric Scale⁵

The main principles for the construction of a sociometric scale are the following :

(a) Firstly, it is necessary to precisely know what is to be measured. The item that would be measured should be clearly specified, defined and demarcated. It is essential to identify and analyse the traits, the conditions or the characteristics which we want to measure before the scale construction.

5. See, P.V. Young, *Scientific Social Surveys and Research*, Prentice Hall of India, New Delhi, 1975, pp. 372-375.

(b) The criteria for rating or measurement should be properly defined, and carefully selected.

(c) Every criterion or factor should be given proper weightage in accordance with some recognised and well-defined scientific technique.

(d) The scale should be simple but precise.

(e) The scale must be reliable. That is, it must produce consistent results.

(f) The scale must be valid. That is, the measurement must be done in an objective manner, and the measuring rod must remain fixed.

(g) The scale must contain proper instructions for use, must be easily understood, should be easily administered and, should be objective as far as possible.

(h) The scale should be quantitatively formulated and expressed so that the data become amenable to statistical analysis.

(i) The scale should be applied on trial basis several times before actual use under varying conditions. If necessary, it should be reformulated and standardised.

For the purpose of scoring, one of the following methods may be used :

(i) *Simple Method*. In this method, arbitrary values are assigned to each item. For instance, for the presence of a factor 1 score may be given, and its absence may be indicated by 0.

(ii) *Difference Method*. The population may be divided into several equal groups, and the significance of percentage difference may be calculated for each group. In this method, the score assigned to each item is the average of the ratios of the differences to their standard errors.

(iii) *Sigma Method*. In this method, the weight given to an item is an inverse proportion to its frequency in the total population. That is, the items which occur very frequently are assigned the lowest weight, and the items which rarely occur are given greatest weight. The absence or non-possession of an item is also given a weight.

It should be noted that a good sociometric scale has to have the following characteristics: *Reliability, validity, simplicity, wide applicability and practicability*. It must have also an objective norm or criterion of measurement. To be realistic, every factor of a sociometric scale should be properly weighted.

Use and Application of Sociometry

Sociometric method has been used quite extensively in social research by many writers like Moreno, Jennings, Festinger, Schachter and Back, Roethlisberger and Dickson and by many others. The method is popular because it is simple and easy to understand. The sociograph or sociogram can aptly present the basic outline of inter-personal relations among the members of a group, and the sentiments underlying these relations. Despite a considerable variation in the individual's choice and the patterns of inter-personal relations within the group, the scores or indices based on sociometric data are fairly stable and useful.

Helen Jennings' sociometric study of leadership has brought home the fact that leadership does not depend on any definite agglomeration of personality traits or characteristics, but it significantly depends on the behavioural contributions made by a person to his group. Criswell's sociometric study of racial prejudice has been able to clearly demonstrate that racial prejudices among children develop only after a particular age. The sociometric study made by Festinger, Schachter and Back has clearly revealed that ecological factors are very crucial in the formation and reinforcement of friendly relations among people. Sociometric studies have been made of entire communities, fraternities, camps, armed forces, factories, schools, colleges and so on. Some sociometric studies have laid special emphasis on morale, race relations, public opinion polling, political cleavages and the like.

A careful sociometric study may prove very useful in revealing the social inter-relations, the pattern of acceptance and rejection and the growth of leadership in a society. Various authors have formulated different indices for measuring social interrelations. Thus, Criswell in her study of race cleavages suggested the index of self preference, based on the actual ratio between in-group and out-group choices, and the expected ratio based on the total number in every group. Zeleny has found indices of sociation, social status and morale; Lundberg and Steel have developed indices of interaction and of cohesion, and Moreno and Jennings have proposed the indexes of the ratio of interest and the ratio of attraction. In fact, sociometric techniques are widely used by sociologists, psychologists and psychiatrists in the studies relating to group structure, social status and personality traits. The method is also being utilised in the fields of mental health, industry, defence and education.

Sociometry is appropriate as a device for studying the areas having inter-disciplinary interests. The method can be utilised without a large scale investment of resources, and hence, has special relevance in low-developed countries. The method is highly pragmatic, and can provide a researcher with useful indices for a large number of empirical studies. Sociometric theory provides a mature behavioural

theory of inter-personal relations. Where a pure sociometric study cannot be conducted, "Near-sociometric" or "Quasi-sociometric" studies may be successfully utilised. For instance, 'group, participation scale', 'sociometric self-rating', 'sociometric survey', 'Guess Who?' method and so on are some of the methodological devices which are quite akin to sociometry. However, pure sociometry has had a number of practical limitations.

Limitations

1. Sociometry is only one of the various measures of studying inter-personal relations. Sometimes, without the help of other relevant aspects of the situation, sociometric study cannot be applied or cannot adequately explain the phenomenon.

2. It may reveal some kind of inter-personal relations among the members of a group or a society. But it cannot explain why only such a relation and not an alternate persists. Its explanatory power is poor. Sociometry has a built-in tendency to regard chance variations as socially very significant. This is illegitimate.

3. Sociometric method has a tendency to minimise the importance of other kinds of data. No remarkable theoretico-analytical work has been done in sociometry to explore and explain the conditions and variables relating to sociometric response.

4. The empirical sociometric works have not covered many pertinent groups beyond the fields of education and institutional groups.

5. Comparatively little attention has been paid to the selection of an appropriate criterion for sociometric questions. Unless an appropriate criterion is selected, sociometric data cannot be meaningful for analysis.

6. The investigator very often does not know what a choice actually means for the subject. Unless the choice has practical implications, it cannot be said to be proper. The making of choice is sometimes difficult on the part of the members of the group, because one may not be acquainted with all the qualities, their dimensions and degrees possessed by the different members of the group.

Despite these limitations, sociometry seems to have sufficient potential for success. Any systematic research unfolding the multi-variate conception of the nature of interpersonal relations may be of immense help to sociometry. There should be persistent effort to link the sociometric theory and sociometric data. A Leeman-type mathematical model representing sociometric choice may be a great step forward in the systematic study of sociometric data.

Social Research

What is Research ?

Research aims at discovering the truth. Research is undertaken to discover answers to questions by applying scientific method. A research may be defined as a "careful critical enquiry or examination in seeking facts or principles; diligent investigation in order to ascertain something". With the discovery of new facts, old conclusions or theories may either be rejected or modified. Research is necessary to examine the extent of the validity of the old conclusions or to find out some new facts and generalisations in connection with the existing ones. Thus, it purports to give a new direction and a new insight into, the existing problem. Needless to say, a research must be based on some problems or on some facts. Inquisitiveness and dissatisfaction are the two main building blocks of any research. In a progressive science, the generalisations may not hold good beyond a certain time-period. With the passage of time, the facts may change, the problem itself may undergo change and so also the concept. Thus, a constant search and research become essential to know the exact truth. The research may establish new empirical generalisations and falsify the old ones. Thus, new theories are constructed.

The purpose of research is to unfold the truth by systematic methods. It may involve the manipulation of concepts or symbols in order to correct or verify the existing knowledge or ideas so that an operational generalisation may be made in the shape of a theory. A research may aim at the following things:

- (i) To find new generalisation with old data.
- (ii) To know old conclusions with new data.
- (iii) To attempt to reach more conclusions from the same set of data.
- (iv) To put forward an entirely original idea or theory, or to discover an unexplored horizon of knowledge.

- (v) To find or to resolve contradictions existing in the area of study.

The prerequisite for a research is knowledge about the area, a searching mind, the related facts and the appropriate technique. In social research, the process must involve the observation or experimentation. For research, factual information is not enough. It is also essential to know things like the objective functions, the system at work and the given constraints and limitations. A research may not lead to an ideal solution to a problem, since it may merely clarify the existing facts and their interrelations. This may not automatically lead to any ideal solution without involving value judgement. A good piece of research must give rise to some problems requiring further research. In other words, a research is not an end to a problem. It is rather the beginning, in the sense that a new research is able to raise a new question.

In social sciences, a researcher is responsible for developing a body of Principles to explain the emerging phenomena adequately and, at the same time, must suggest practical guidelines to solve the immediate problems. Although these two processes are logically distinct, they are dependent on each other in the long run, for one cannot be realised without the other. However, the basic or fundamental research may give rise to some knowledge which may be immediately useful. An investigator may be concerned either with pure theoretical research or with purpose-oriented study.

Research Process

The research process consists of a number of related steps which are essentially interdependent. As said earlier, research starts from the conception of a problem. Then collection of facts and information will follow and these will be processed by scientific techniques and tools to arrive at a reasonable conclusion. The following steps are involved in research :

- (i) Formulation of the problem in conjunction with the purpose of the study.
- (ii) Description of the research design.
- (iii) The methods of collection of data.
- (iv) Results of the study.
- (v) Policy implications and the conclusions

The formulation of the research topic or project has to be based on a number of considerations which are as follows :

(1) The problem which requires solution must be from within the area of interest and feasibility of the research worker. Topics requiring immediate solution or involving controversy may be given preference over other ordinary topics.

(2) The entire research project may be further broken up into a number of small and distinct projects of manageable size.

(3) It is essential to formulate the hypothesis which will be helpful for the collection and analysis of data. The hypothesis has to be subsequently tested by facts.

(4) The definitions of the concepts and symbols involved must be given precisely. The definitions must be operational, and the conceptualisation must be simple but clear without any ambiguity or contradiction.

(5) The methods and analytical tools should be specified, and applied to find out the result of the study.

It is necessary to relate the generalisation to the existing body of knowledge. This involves a thorough knowledge of the existing literature and a foresight of the emerging trend.

What is Social Research?

A social research encompasses scientific investigations conducted in the field of social sciences and also in behavioural sciences. Social research is a very broad category within which there are many sub-classes. According to P.V. Young, a social research is "the systematic method of discovering new facts or verifying old facts, their sequences, interrelationships, causal explanations and the natural laws which govern them."¹ Social research involves the application of scientific method for the understanding, studying and analysing of social life in order to modify, correct or verify the existing knowledge as a system.

Social research has some distinct characteristics. It studies human behaviour and social problems. The main idea behind such research is to discover new interrelations, new knowledge, new facts and also to verify old ones. In a progressive science, it is essential to verify constantly the old facts and conclusions. Such verification is warranted if the technique of analysis improves, the concept itself changes or new facts or data become available. Social research tries to find out the causal connection between various human activities and the natural laws governing them by means of logical and systematised methods. Human behaviour may be motivated by certain rules and laws. The main purpose of social research is to discover those laws which can be the proper guidelines for studying human conduct and behaviour. Social research has many objectives of which the following are the cardinal ones :

1. P.V. Young, *Scientific Social Surveys and Research*, Prentice Hall of India, New Delhi, 1975, pp. 30-33.

Objectives and Motives of Social Research

(1) Social research aims at understanding the human behaviour and its interaction with the social institution.

(2) The purpose of social research may be the acquisition of new knowledge in order to gain insights into existing problems. The collection of new facts is also essential for the progress of the science.

(3) P.V. Young observes that the primary aim of social research is to understand social life and thereby to gain a greater measure of control over social behaviour. It is necessary to investigate into the causes of certain social phenomena in order to cure the social events. This necessitates the perfect understanding of the human society and its working. But all social research does not necessarily aim at finding out the immediate solution to some problems. It may not be concerned with immediate social planning or therapeutic measures or practical social reform. It is rather concerned with the understanding of the fundamental social process involving human behaviour, human institution and human relations.

Another purpose of social research is to try to improve our tools of analysis, or to test these against the complex human behaviour and institutions. It is no doubt difficult to predict human behaviour individually; but it is comparatively easy to predict mass behaviour or group behaviour with certain measure of accuracy. As our knowledge of the social variables increases, it becomes possible to predict the social events with far greater accuracy,² and the conclusions arrived at by social research will have broad applicability. Social research should, in the short run, try to develop special theories with limited applicability; but in the long run, attempts may be made to put forward more general theories.³

According to P.V. Young, there are four main motives for social research. They are described below :

- (a) Desire to understand the cause-effect relationship of some social phenomena. Due to inadequate knowledge or obscure facts, causal connections may not be immediately known, necessitating social research.
- (b) Social research may be motivated by the desire to discover new theories, concepts and techniques in order to gain knowledge more efficiently and within a short time horizon. Recently, quantitative techniques are being applied to social research for more accurate and precise results.

2. G.A. Lundberg, *Social Research*, Longmans Green & Co., New York, 1926.

3. R.K. Merton, *Social Theory and Social Structure*, Free Press, Glencoe, p. 9.

- (c) Both curiosity and necessity may be the important motivating factors for social research. Human minds always want to know the unknown and explore unexploited areas. Social research is a means by which unknown factors may be explored to explain a social phenomenon.
- (d) Understanding, analysis and explanation of social phenomena are the primary motivating factors behind social research. The main idea of social research is to appreciate the social dynamics, measure its possible effects and work for an operational solution.

Types of Social Research (Subject-matter)

There are, mainly three types of social research : (i) Fundamental or pure research, (ii) Applied research (iii) Quasi-social research.

(i) *Pure or Basic Research* aims at primarily obtaining theoretical knowledge and the logical process involved in the phenomenon. It pursues knowledge for the sake of knowledge itself. In such an enquiry, many assumptions are to be made, and some fundamental principles are to be involved. It is more often than not an intellectual exercise aimed at finding some theoretical conclusions. Such a research may verify the old theory or establish a new one. Fundamental research is essentially positive and not normative. That is to say, it explains the phenomena as they are and not as they should be.

(ii) *In Applied Research*, the results of fundamental research are applied with reference to the social phenomena. Whereas fundamental research is theoretical, applied research is empirical and practical. In applied research, the research result is practically applied to solve the immediate problems and involves normative policy prescription. It, therefore, incorporates some value judgements and is based on utilitarian approach. Applied research can test the theories empirically, and can be helpful for improving tools and techniques. Basic research may be the building block for applied research. However, it must be noted that the distinction between "pure research" and "applied research" is a matter of degree, and both can be said to be interdependent.

(iii) *Quasi-social Research*. Some problems in social sciences are not unique problems, belonging to an exclusive discipline or area of research. Some problems, for instance, may be economic-political, some socio-economical or some may be socio-political. These problems will come under quasi-social research.

Basic Postulates (Presumptions) of Social Research

Social research presumes the existence of the following situations:

- (1) *Possibility of an Objective Study.* It is presumed that the researcher would be able to make a neutral or unbiased study of a social problem. Although it is difficult in practice, it is not impossible altogether to attain an impartial judgement. This, of course, requires non-interference, sincerity honesty and disinterestedness.
- (2) *Existence of Some Social Norm or Law.* It is presumed that in society there is some kind of natural law or norm, and any social event is based on it. Thus, prediction becomes a possibility, for, there is some definite trend of social phenomena at least in the short period.
- (3) *Causal Relationship.* In social research, a cause-effect relationship between social behaviour and events is presumed to exist. Thus, attempts are made to find out the effects from the cause/causes (*a priori* consideration), or cause from the effect (*a Posteriori*). It is presumed that similar causes produce similar result under similar circumstances, for the Nature is uniform. There is some order in social relation.
- (4) *Representative Sample.* Social research presumes the possibility of drawing a representative sample from the whole of the population. It also assumes that the result of the study from the representative sample may be made applicable to the whole population. Social research is largely based on sampling technique, in the event of vast and heterogeneous population data, and for obtaining better results, representative sampling technique is adopted.
- (5) *Existence of Similar and Ideal Group.* It is presumed that society consists of fairly homogeneous groups known as the *Ideal Group*, such that the behaviour of this ideal group is the same as that of other groups. That is to say, they have similar likes and dislikes and similar feelings. For instance, if different groups of people from the same profession emigrate, the causes would be regarded as similar for all groups.
- (6) Social events are also amenable to scientific study, for human behaviour follows some definite trend.

Utility of Social Research

Social research is a curious course of enquiry, satisfying human desire to know the facts hitherto unknown or obscure. It increases the social stock of knowledge and so also its flow in various branches of social dynamics. It focuses our attention to social reality and social events. It strengthens our desire for truth and opens up before our eyes, hidden social mysteries. Social research helps us to scientifically judge and accept a phenomenon by discarding all superstitions, cliches, orthodox beliefs and ignorance covering the phenomenon. The following are the main practical utility of social research

1. *Control Social Phenomena.* Knowledge is power. Social

research can equip one with detailed and sufficient knowledge about the working and organisation of a society and its institutions. In this way, it can give greater power of control over the social phenomena. The growth of leadership is facilitated by social research.

2. *Social Planning.* Any planning would depend on the systematic knowledge of the resources, problems desiderata and objectives of a society. Social research can give us the detailed picture of the contemplated aspects of social planning—the means and ends and so on, so that a rational and optimal social plan can be formulated. Social research is immensely valuable in procuring the necessary information and data for social planning.

3. *Social Understanding and Goodwill.* Social research pinpoints the need for interdependence among different social groups. It reveals the truth by dispelling superstitions, ignorance and taboos. It gives a clear weightage to independent and reasoned opinion, and helps to promote goodwill and understanding. It brings out the unity among diversities and helps to strengthen social cohesion.

4. *Social Growth.* Social research points out to society a right and normative way of development by pinpointing the evil effects of the wrong course of action. Given the constraints, the direction for social growth can be given by social research by study of societal organisations, institutions, values, motivation and so on. The fact that social research can lead to better social control, planning and cohesion by itself goes to prove that it may also lead to better social order, functioning and growth.

5. *Social Prediction.* Social research aims at finding an order among the social facts by making causal connection. This affords a sound basis for prediction in a large number of cases. Although the predictions cannot be perfect due to a variety of limitations and constraints in the majority of cases, a reasonable result may be ascertained. On the basis of the reasonable value of prediction, better social control and planning can be attempted through social research.

6. *Modernisation of Tools and Techniques.* With the progress of social research, the tools and techniques of analysis become modernised and up-to-date. Necessity is the mother of invention. Due to the exigency of new situations, better tools for social research may be devised and, better and more efficient results may be expected.

7. *Social Welfare.* Social research can unfold and identify the causes of social evils. In this sense, it can help to take the necessary action for eradication of social evils. Social research can give sound guidelines for appropriate measures of reform and social welfare. Social research can bring out the magnitude and the real cause of social evils, thereby devising ways to eradicate them, thus indirectly maximising social welfare.

Qualities of a Researcher

A researcher is one who knows more and more about less and less. This shows that a good researcher must have a specialised area of interest. It is almost impossible to delineate the actual qualities of a good researcher. However, some broad qualities of a good researcher may be indicated in the following general way:

(1) *Scientific Mind.* A researcher must have a scientific frame of mind. He should not be influenced and guided by pride and prejudice, and by the superficial facts. He must give up personal likes and dislikes. The enquiry must be performed along scientific lines. He must be bold enough to discover new things and to discard superstitions and taboos.

(2) *Seeker of Truth and Knowledge.* A researcher must be a seeker after truth. Therefore, he himself must be truthful and sincere. He must have the desire for knowledge. The lure of discovering the unknown fact is the starting point of the research. A researcher has to be prepared to make any type of sacrifice in terms of time, money and energy to find out the real truth.

(3) *Alertness, Insight and Imagination.* A scientific mind must always be alert to appreciate minutest changes in situations. This habit has to be patiently cultivated and practised. The mind must be prepared to work under all circumstances. A researcher should be accurate in observation, quick in perception and must have precision of statement. His mind must be thoroughly disciplined. He must have a high degree of imaginative power and be able to catch the clues by probing deep into the matter.

(4) *Quick Power of Understanding.* A research worker should have the ability to grasp things quickly so that he is in a position to make the best of his research.

(5) *Trained and Educated.* A researcher must have intimate knowledge of his area of research. The concepts, symbols and the implications of his project must be very clear to him. He must have sufficient experience and training to understand, analyse and tackle the problem. A researcher must have an analytical mind. Simple description of a problem is no research. The results must be found out by rigorous method. Therefore, a researcher must be acquainted with the sophisticated and latest technique of research. He must be very clear about the methodology he is following.

(6) *Patience and Perseverance.* Research is a curious mixture of success and failure. It is an intellectual exercise requiring endurance and patience. A researcher must not feel defeated at any stage. He requires supreme courage of conviction. It may require many years to complete a research project, and the researcher must not give up hope.

(7) *Objectivity.* A researcher must be objective in his approach. A scientist must try to avoid sentimental and emotional interpretation of his result. He must have an open mind. He must also be very cautious in his approach.

(8) *Knowledge of Scope and Limitations.* A researcher must clearly know as to what he is going to show and how he can prove his case. He must have the capacity to clearly distinguish. But he must not be too ambitious. He must know his limitations and constraints. A good researcher must be able to answer who, what, when, why, where, how and so on, in relation to his own topic of research. He must know where to begin and where to end.

Methods of Social Research

There is no clear-cut method of social research, nor is it possible to suggest a definite method of social research. In fact, there is no one methodology for any research. Research methodology will depend on the topic itself, the techniques, and tools, the data available and the experience and capability of the researcher. The purpose of research may often be helpful in determining its methodology. We should not get confused between the methodologies of research and the different methods of collection of data. Research methodology relates to the application of appropriate analytical tools and techniques in order to arrive at the conclusions. Some of the methods very often used in social research are:

1. *Evolutionary and Comparative Methods*⁴. Evolutionary method or Genetic method attempts to trace the history of development and the evolutionary stages of a phenomenon in order to relate it to a particular stage. It also indicates the reasons for the various changes.

In comparative method, truth is discovered by a comparative analysis of similar groups. In this way, the basic law or the common trend is traced, and it becomes easier to explain the existence and working of a system, institution or phenomenon. Comparative method is used where evolutionary method cannot be properly applied.

2. *Experimental and Field Study Methods.* Experiment is controlled observation.⁵ In physical sciences, experiments are very widely practised; but its application is limited very much in social sciences. Since human behaviour cannot be controlled and put to laboratory test, the scope of experiment in social sciences becomes very limited. However, some of the difficulties in experimentation in social sciences can be avoided by developing better techniques and tools. Under this method, the subject of study is given, and some external stimuli and their effects are closely watched and studied. It is essential to manipulate the causative factors or variables under experimental method in

4. For detailed discussion, see the Chapter on *The Methods of Social Sciences*.
5. For a detailed study of Experimental Method, see the Chapter on *Observation and Experiment*.

order to determine the cause-effect nexus. Experiment, of course, can be conducted either in the field or in the laboratory depending on the phenomenon being studied.

Since the scope of controlled experiment is limited in social sciences, Chapin has suggested the use of "natural experimentation" or "field research". Under this method, the researcher has to make a field study or survey in order to collect research materials or data. The phenomenon is empirically studied and examined, and a conclusion is finally arrived at regarding the cause and the effect of the phenomenon. This method may be called the method of observation.⁶ This method is becoming increasingly popular in social sciences, particularly in Economics and Sociology. Many workable hypotheses have been based on empirical studies nowadays.

3. *Qualitative and Quantitative Methods.* The method of social research may be either qualitative or quantitative in character. Under the qualitative method, qualitative description or experience becomes the basis. Whatever information is collected, is simply arranged and described, and the obvious inferences are drawn. The conclusion in this method is not based on any rigorous analytical technique. Qualitative method is essentially philosophic in nature.

Quantitative or the mathematical method of social research is based on rigorous and sophisticated techniques of analysis. Different statistical or mathematical tools and techniques are employed in the quantitative method to find out the correlation or relationship. Under this method, the hypothesis is mathematically tested. It relies on a mathematical technique of measurement of data. In such a technique, it is possible to find out the relationships among many variables. The result obtained by the application of quantitative method, is more precise and certain. Recently, the quantitative method is being increasingly applied to social sciences, like Economics, Sociology, Psychology and so on. These sciences have their own mathematical branches, e.g., Mathematical Economics, Mathematical Sociology and Mathematical Psychology, which deal with the application of quantitative technique. In Economics, a special branch known as Econometrics has developed, which can successfully apply the quantitative method for empirically studying the economic phenomena.

There are five main phases of social research:

(1) Formulation of hypothesis, (2) Collection of data, (3) Classification of facts, (4) Generalisation (conclusion) and (5) Empirical Verification (see, for detail, Chapter on *Research Design*).

Data for Social Research

Broadly speaking, there are two sources of material or data for

6. See, the Chapter on *Observation and Experiment*.

social research: (i) documentary source and (ii) field investigation. Documentary sources include published or/and unpublished materials. Published books, journals, reports, mimeographs, documents and so on contain important data for research. The data may also be collected from unpublished articles, report books and theses. These are generally secondary or indirect data. The primary or direct data may be collected from personal interviews, completed questionnaires, surveys, direct information and observations and experiments. When the data from the secondary sources are inadequate, or are not available, the primary sources of data have to be tapped. The different sources of data are briefly described below:

A. Documentary Sources

1. *Books.* The related books may throw sufficient light not only on the theoretical aspect of the problem, but also on the empirical evidence. The researcher has to consult all the books and existing literature on the problem so as to acquaint himself with the postulated theories and the available empirical evidence. This is essential for avoiding duplication and for a critical and new analysis. The evidence given in books may be used either to counter certain prevailing notions or to substantiate them.
2. *Published Official Data.* Different institutions publish data regularly on some socio-economic aspects. These data may be an important source for social research. The data published by the Government can be said to be more reliable than those published by private organisations.
3. *Survey Reports.* Various agencies, both government and non-government publish from time to time the reports of the surveys undertaken by them. These reports can be an important source of data for social research. However, the researcher has to look to the relevance, the time period of study and the degree of reliability before using such data for the purpose of research.
4. *Memoirs.* Personal documents of some people, memoirs, autobiographies and diaries and correspondence may also be helpful sources for collection of materials. Speeches and writings may also contain rare materials for research.
5. *Travelogues.* Accounts of travels and journeys undertaken to various parts of the world, reflecting upon the socio-economic, economic-political or cultural life of the people met can reveal useful information for the purpose of research.
6. *History.* Historical accounts of a phenomenon or system or institution is a valuable documentary evidence in research. It is also useful in linking a particular stage of evolution to a particular period in history. Many lessons can be learnt and predictions may be helped by historical data and evidence.

7. *Unpublished Documents.* Sometimes very crucial material is to be found in unpublished letters, records, theses and reports of various persons and institutions. A researcher has to carefully scan these materials before use. The personal idiosyncrasies of the authors of these documents must not be included while collecting the research materials.

B. Field Sources

The following are the main direct or field sources of data.

1. *Direct Survey or Observation.* In this method, the researcher has to make a survey of an area or observe directly and personally, the collection of primary data relating to the phenomenon. If the coverage is to be very wide, field investigators may be appointed. The collection of data in this method requires strict supervision and contact.

2. *Information.* Information may be collected from the especially appointed informants, or from people who have witnessed the events. The people having intimate knowledge of the case may also supply the necessary information. The informers must be neutral. Information must not be collected under duress, threat or temptation. The information may be collected by the direct interview method.

3. *Questionnaires.* When people cannot be contacted or interviewed directly, questionnaires, containing relevant questions, may be sent to them. After their replies are received, information may be processed and gathered from the questionnaires for direct use in research.

Thus, we find that the sources of data for research are many and varied. Depending on the topic of research some crucial sources have to be chosen by the researchers. It has to be noted that the search for material and data constitutes a part of research. While collecting and compiling data and materials, the researcher must use his critical judgement and ability to separate the essential things from a large body of unwanted heap of matters. Like swans, which can, according to legend, separate milk from water, he should have the ability to pick and choose the best available material, discarding the useless and unnecessary ones.

Selection and Formulation of Research Problem

A: Selection of Research Topic

The topic for research may be based on a number of considerations. It may be based on some practical consideration or by some theoretical and intellectual interest. A research topic may very well be selected from the burning problems of the time. It may also be based on the special interest and the convenience of the researcher. A researcher may be guided by some special consideration of his own choice. He may choose a topic where he, as he thinks, can show his originality and distinct ability as a researcher. A topic of research may take into account the existing information gap in various theories, and accordingly, the researcher may choose his topic so that the information gap may be minimised.

Sometimes a research is undertaken to suggest an alternative and a better theory or analysis. Intellectual and scientific interest may lead to the exploration of a wide range of topics for research. The researcher, guided by intellectual curiosity, may take up a topic which is relatively unknown among the people of his profession. In order to find out some differentiations, a researcher may explore the controversial area of research. On controversial topics, a researcher may be specially interested to find out the real truth involved in the matter. He may also test the validity of some existing theory on the basis of new facts and data and/or improved technique of analysis.

A topic may be so chosen that new and more useful conclusions can be found out with the existing data. In the case of an already existing, highly developed theoretical system, a research topic may be chosen to test specific predictions on the basis of the received theory. It is sometimes opined that values play some role in the selection of a research topic. This view, however, is not always considered to be true. Social scientists having different notions of values choose different topics for social research. In case, however, a topic

is chosen according to some personal preference, the researcher must be very cautious to guard against the bias that is likely to enter into his research. Different societies place premiums on work on different topics. For instance, it is considered more prestigious to work on a problem in cybernetics than on the local transport system. Sometimes, a research topic is not selected by the researcher himself but has to be chosen from among the given lists of topics of an institution where he is working.

In choosing a research topic, a researcher has to consider a number of things, e.g., his ability, the time at his disposal, the available resources, the availability of data and so on. It should be remembered that research is primarily a function of an objective or objectives valued by an individual, institution or country.

B. Formulation of Research Problem

Once the topic for research is selected, research cannot immediately start unless the specific problem is formulated which can be investigated by scientific method. It is very necessary to formulate a piece of scientific enquiry before the collection of data. Needless to say, the formulation of enquiry must recognise some difficulty, be it practical or theoretical. It is the difficulty or problem which guides our search for some order among the facts in terms of which the difficulty is to be removed.¹ The difficulty may be experienced with some social problem, or with the failure of the theoretical system or prediction. In fact, the formulation of a problem is more important than its solution. However, every problem is not a scientific problem or a research problem. In the matter of problem formulation for research, Merton has distinguished the following three principal components:²

- (1) Originating the question.
- (2) Rationale of question.
- (3) Specifying question.

(1) The Originating question is based on the fundamental objective of the present research. That is to say, what is the specific problem which a researcher wants to solve? The originating question is the first problem in the formulation of research. The originating question may doubt the existing facts about a problem. It wants to discover new and more decisive facts giving rise to the problem at hand. Some social facts can explain in a particular way the problem that exists, but these facts may only be superficial facts, and not real. Thus, a doubt is raised about the facts themselves, and hence a

1. Cohen and Nagel, *An Introduction to Logic and Scientific Method*, New York, 1958.
2. R.L. Merton, *et al. (Ed.) Sociology Today*, Harper, New York, 1968.

discovery of new facts is undertaken through research. The questions that may be raised at this stage may be fact-finding questions. This shows that all plausible facts may not be the real facts, and all plausible beliefs may also not be necessarily true. The truth-value of these beliefs and facts have to be discovered by research. The originating questions are not, however, uniform. Some questions may be related to concepts, some to facts, some to the existing system, some to empirical validity and some may be related to the whole structure or organisation.

(2) It is also necessary to know the reasons behind the question that is raised. That is to say, why is the question being raised at all? If the question is answered, what will be the benefit? In other words, the rationale of the question helps us to distinguish between a valuable and a trivial question. If the question is found to have any scientific import, the question is considered for answer, otherwise not. It is also necessary to know whether the question is relevant or not. The relevance may be either theoretical or practical. The answer to the question raised may improve the theoretical knowledge, enlarge the scope of theoretical enquiry, or may lead to a new theoretical construct. The conceptualisation and understanding may be made clear by answering such questions; or, some theoretical inconsistencies may be removed from the system of analysis. A new theory may possibly develop and that may be considered in many respects a better one than the existing theory. The old theory may also be proved to be wrong. The suggested answer to be given by research may be instrumental in discovering a new analytical model which can answer many questions, and which is, therefore, broader and better. The answer may maximise the welfare of the whole or a part of the society, cure many diseases or find out some practical solutions to knotty problems. Thus, the question may have either theoretical interest or practical utility. It must not neglect either of these two.

(3) The question which has originated the research must be specifically and very clearly stated. A broad question may be decomposed into several specific questions, each of which can be answered separately and conveniently by the researcher. In specifying the question, it has to be stated how it would be answered by a particular set of variable or data. For answering a specific question, a particular type of observation becomes essential. However, every concrete situation is not *per se* strategic. It is what the investigator brings to the situation that makes it strategic.³ Specific questions can be precisely and successfully answered for the benefit of the society. In the final stage of the formulation of the research problem, the general question can be transformed into a series of specific questions so as to indicate the types of situations that can afford the strategic observations to answer these questions. Needless to add,

3. R.K. Merton, *Social Theory and Structure*, Free Press of Glencoe, N.Y.

no solution can be found so long as the questions remain non-specific and ambiguous. The questions should be simple, pointed, specific, clear and empirically verifiable. When answers are found to these specific questions, it is possible to find out a solution to the problem.

The first step in the formulation of research is to make the problem specific, concrete and objective. The formulation of the topic into a research problem is the first step in a scientific investigation. But unfortunately there is no standard rule in the matter of formulation of significant question in a given research area. It is very often the task of a trained, sensitive, experienced and alert mind. As Cohen and Nagel observe, it is a mark of scientific genius to be sensitive to difficulties where the common people take them easily. The problem must be perceived by the researcher himself. A searching mind remains always dissatisfied with the existing ideas, system and notions. This growing dissatisfaction is the basis of formulating a research problem.

Conditions and Methods of Problem Formulation

(1) The first essential condition for the formulation of a research problem is the systematic immersion in the subject matter through first-hand observation. It is always helpful to study extensively the existing literature on the subject, to discuss the matter with experienced people and to deeply think about the problem.

(2) Sometimes, field observation may be of immense help to the researcher. He may make a preliminary or pilot study, or an exploration. The researcher must be well acquainted with the relevant theories and empirical generalisations in the area of research. He should be familiar with the result of the findings in the similar area. He has to find out the existing gap in the theory, or inconsistency, inadequacy, or loophole. All these will give him an insight for problem formulation.

(3) The researcher may undertake an experience survey and discuss the matter with the relevant learned minds. He may seek a comment on his proposed topic and its formulated problem from the existing authorities on the topic. He should have his mind open, flexible, critical and curious.

(4) The topic itself must be of manageable magnitude. This is an initial necessary step in problem formulation.

The researcher should himself try to suggest some solutions or explanations of the difficulty experienced by him (Hypothesis). He must properly define the involved concepts in a practical manner so that the definitions become workable propositions. It is possible to identify some aspect of the topic which can be formulated into a specific research problem which is feasible to investigate. However,

it should be noted that formulation and reformulation of research problem is a continuous process; and in a sense, no process is final and last. As Max Weber said, "Every scientific fulfilment raises new questions; it asks to be surpassed and out-dated."

C : Objectivity in Social Research

Objectivity is the willingness and ability to examine evidence without any bias or prejudice. In any science, objectivity is the first condition of research. Subjective study involves bias and value judgement, and hence, is not a rational basis of research. Objectivity of truth implies that the phenomenon is in reality independent of personal feelings, likes, dislikes, prejudice, hopes and fears of any individual all of which we find out not by intuition and speculation but by dispassionate observation and experiment.

It is very difficult to achieve objectivity in social sciences where human behaviour is being studied. The researcher is, more often than not, influenced by personal prejudices, likes and dislikes, beliefs, faith and so on. These may seriously impair the truth-value of the study. Subjectivity by itself is not harmful, but it must not enter into the analytical framework of the research. Objectivity, by itself, however, does not guarantee rationality, but failure to be objective will prevent a researcher from attaining rationality. The failure to be objective is attributed to the simple fact that a researcher, as a social being, participates in social affairs. But this is not a weighty argument.

The problem of objectivity is partly one of knowing the truth or reality. Objectivity involves the correct method of tackling the problem and the question of epistemology. There are various influences which stand in the way of objectivity. These are : (i) personal emotions, (ii) personal motives, (iii) customs and superstitions, (iv) self interest, (v) complexity of the subject-matter, (vi) qualitative nature of subject matter (vii) lack of uniformity (viii) misunderstanding caused by lack of knowledge. (ix) quick and hurried performance (x) moral values (xi) ethnocentrism (xii) external pressure (xiii) ignorance, and so on.

In the absence of any reliable indicator or objectivity, the usual method is to fall back upon a simple measure, i.e. testing as to how the theory stands to reason. If it does, it can be regarded as objective. But this presumes that our judgement is unbiased. It cannot be said with any measure of certainty that there is a general failure among the social scientists to attain objectivity. A case cannot be made against the possibility of an effective degree of objectivity in social investigation.

However, there are many sources and possibilities of bias in a social enquiry. The following are the different types of bias :

- (a) There may be the personal bias of the researcher.
- (b) The informer may himself be biased.
- (c) There may occur sampling bias in the collection of data due to unrepresentative sampling.
- (d) The questionnaire may be biased.
- (e) There may be a faulty method of data collection, and the data themselves may be faulty or biased.
- (f) Faulty analysis and generalisations may also be due to personal bias.
- (g) There may be biased common sense.
- (h) The attitude and aptitude of the researcher may also be biased either against or in favour of a nation or theory.

The question, then, is how to achieve objectivity in social research? The true remedy is to make the researcher conscious about the different sources of bias and subjectivity. An effective way to eliminate personal influence would be to bring the different theories together and ensure that they are openly and mutually criticised. Criticism is one of the most useful ways of cooperation, and construction of better theories. "Criticism is the very life blood of science."⁴ In fact, "invalidation, no less than verification of propositions, is a progress in enquiry."⁵ However, it must be ensured that the argument of power does not outweigh the power of argument. Social enquiry may be regarded as a competitive collected enterprise, and this notion can ensure some measure of objectivity. A detached intellectual, as Karl Mannheim observes, with no social or political affiliation, should be able to achieve a fairly good measure of objectivity. Research should be taken as a separate religion quite distinct from others, having its own code of conduct and professional ethics.

Certain research procedures based on scientific method may also go a long way in achieving some amount of objectivity in social research. In general, the following measures may prove helpful:

(i) *Use of Standardised Terms and Concepts.* The terms and concepts should be given scientific connotations, and be uniformly used for the purpose of research. The terms and concepts should be very clearly defined and cautiously used. This will ensure the proper of symbols and words, and minimise personal bias in interpretation. If the terms and concepts are standardised, much of the existing confusion in the field of research may be avoided.

- 4. F. Kaufmann, *The Methodology of the Social Sciences*, Oxford University Press, N.Y. 1944, p. 244.
- 5. Karl Pearson, *The Grammar of Science*, p. 11.

(ii) *Use of Empirical Method.* The empirical method of enquiry based on data collected from the published reports, surveys and studies of the reliable institutions may minimise personal bias. Some personal bias is likely to come in if the data are collected by the investigator. The source of data must be authentic and the method used to arrive at the conclusions should be objective.

(iii) *Use of Quantitative Method.* Quantitative method of research is helpful to bring about some measure of objectivity. The statistical and mathematical methods as tools of analysis are free from subjective bias. Qualitative method of evaluation is essentially subjective. A research procedure based on quantitative method should be given preference wherever possible.

(iv) *Group Research.* A topic of research, when investigated by a group of researchers either jointly or individually will have more objectivity than subjectivity. In this method, the technique of analysis remains the same. Since the subject and methodology remain the same, the result may be expected to be more or less the same. A comparison of the results arrived at by different researchers may help to eliminate the personal bias, if any. Even in the case of group research, subjective elements may be present; but their magnitude may be minimised to a great extent.

(v) *Use of Experimental Method.* Experimental method is quite helpful to test the objectivity of data and the veracity of result. Experiment is study under controlled conditions. Although controlled experiment is not possible in all social cases, it can be used within limited extent. This method keeps the problem free from external influence at least during the period of study.

(vi) *Use of Random Sampling.* Random sampling technique is apparently free from personal prejudices of the researcher. In such a technique, all the units have equal importance and they are selected without any pride or prejudice.

(vii) *Use of Mechanical Method.* Mechanical devices may reduce the chance of subjectivity in the matter of collection of data and interpretation of result.

(viii) *Use of inter-disciplinary Technique.* The study of a problem may be related to the similar studies in other fields of enquiry. The application of knowledge of one area in another area of research may corroborate each other's findings and increase the degree of objectivity in social research. A coordination has to be established between the techniques followed in studying the problems of different branches of social science. The help of various specialists may be taken to study a social problem. This is sure to reduce subjectivity in social research.

Needless to add, the use of scientific methods and techniques can go a long way in giving a fair dose of objectivity to social research. Much, however, depends on the attitudes of the researcher himself, for it is he who is the hero of the whole show.

Research Design

Meaning and Nature

A research design is a plan of the proposed research work. A research model or design represents a compromise dictated by mainly practical considerations. Suchman has pointed out that "a research design is not a highly specific plan to be followed without deviation, but rather a series of guide posts to keep one headed in the right direction." According to Jahoda, Deutsch and Cook, "A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure". A research design should be based more or less on some methodology. The research design should be made once the topic and problem of research have been selected and formulated, objectives have been properly outlined, concepts have been properly defined and the hypothesis or hypotheses have been properly framed. A research design should be able to provide answers to the following queries:¹

- (a) What is the study about and, what type of data is required?
- (b) What is the purpose of the study? What is its scope?
- (c) What are the sources of the needed data?
- (d) What should be the place or area of the study?
- (e) What time, approximately is required for the study?
- (f) What should be the amount of material or number of cases for the study?
- (g) What type of sampling should be used?
- (h) What method of data collection would be appropriate?
- (i) How will the data be analysed?
- (j) What should be the approximate expenditure?
- (k) What would be the methodology of the study?
- (l) What should be the specific nature of the study?

1. P.V. Young, *Scientific Social Surveys and Research*, pp. 13-21.

The process of a study is best promoted by a research design or plan, which can be of definite help in achieving optimum objectivity, efficiency and reliability. However, any research design is only tentative in the sense that as the study progresses, new facts, new ideas and new conditions may make their appearance which may necessitate a change in the original paradigm. Thus, a research design cannot be an inflexible paradigm. A methodologically designed research may lead to the following advantages:

- (i) It may result in the desired type of study with useful conclusions.
- (ii) It may lead to more accurate result, or help to reduce inaccuracy.
- (iii) It may give optimum efficiency and reliability.
- (iv) It may minimise the wastage of time, and beating about the bush.
- (v) It may minimise the uncertainty, confusion and practical hazards associated with any research problem.
- (vi) It may be helpful for the collection of research material and testing of hypothesis.
- (vii) A research design is a guide post for giving research a right direction.

An ideal research design, according to Ackoff, is concerned with specifying the optimum research procedures that could be followed where there is no practical constraint.² However, it is very difficult to prepare an ideal research design in a social science. The research design has to be translated into a working procedure, which should be based on a statistical model, and take into account the concrete situation by making every aspect clearly explicit. A practical research design has the following three phases:

- (1) *Observational Design*. This specifies the conditions and methods of making observation.
- (2) *Statistical Design*. This will take into account the quantitative and statistical aspects of the design, such as the technique of study, the methods of model building, and observation, and experiment and so on.
- (3) *Operational Design*. This relates to the use of specific technique for the operation of the model already designed.

It must be stated that these phases are not independent but they are rather interdependent and overlapping. In a sense, every research design is a class by itself and is different from other research designs.

2. R.L. Ackoff, *The Design of Social Research*, Chicago University Press, 1961, p. 11.

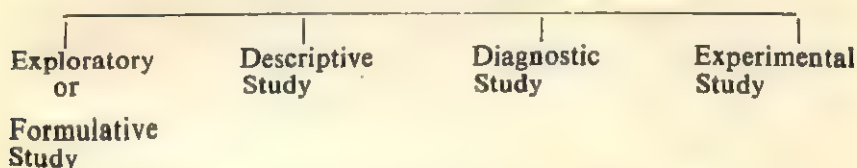
Every research study has its own specific purpose, and depending on the purpose, the research studies can be classified into several categories.

Purposes/Objectives of Research Study

- (1) To gain familiarity with the phenomenon or event in order to understand it and achieve new insight. This can be helpful in formulating a very precise research problem or hypothesis.
- (2) To accurately lay down the characteristics of any group, situation or individual.
- (3) To determine the frequency of the occurrence of a phenomenon, or its association with something else.
- (4) To test a hypothesis of a causal relationship between variables.

A study having the first objective is called a *Formulative or Exploratory Study*. A study which wants to portray the characteristics of a group or individual or situation is known as a *Descriptive Study*. A study which wants to determine the frequency of occurrence of an event or, its association with something else, is known as a *Diagnostic Study*. An *Experimental Study* aims at testing a causal hypothesis for the purpose of ascertaining the cause-effect relationship. Thus, we have the following four types of studies, according to the purposes of study:

Typology of Research Study



However, the above typology is not a fixed scheme, for these studies are not very different from one another. The classificatory scheme is a simple analytical device. We can now analyse the different research designs on the basis of different types of studies.

A. Exploratory or Formulative Study

An exploratory study is the primary stage of research, the next stage is occupied by the descriptive study and the final stage of research is to find out causal relationship. However, a study can very well be a mixture of different elements, namely, exploration, description and experimentation.

In an exploratory study, it is necessary to be familiar with the subject, to determine the scope and limit of research, to clarify the concepts and to formulate the hypothesis. In an exploratory study, the main idea is the discovery of facts and insights. Therefore, the research design in this case must be flexible, to permit the incorporation of different aspects of the phenomenon or event. The following methods may be very helpful for exploratory research:

- (a) Review of Pertinent Literature.
- (b) Experience Survey.
- (c) Case Study.

Survey of Literature : The researcher has to survey the existing literature to see what has been done to the subject of study, how it is done and what conclusions were arrived at. His review of literature may give him an insight into the problem so that he may be more familiar with the subject. Survey of literature will help a researcher to find out the research gap. He can know what has actually been done and what yet remains to be done on the specific problem. All these may be helpful to develop a meaningful hypothesis, with the help of stimulating clues. A researcher can get the idea of relevant literature from the "Annotated Bibliography" relating to his topic and also from the "Abstracts of Articles" being published by different journals. He can also refer to the Bibliographies of the relevant books. A researcher can also procure materials from the related disciplines.

Experience Survey. Informal interviews with the experienced people of the area of research may be very helpful in getting an insight into the subject and its various facets. People who are or have been doing some work on this type of problem or who have theoretical or empirical knowledge or ideas on it, may be consulted with profit. Such people may be from any profession, group or country. The researcher may prepare a list of respondents and may interview them informally or formally. But every Tom, Dick and Harry should not be interviewed for that would be a sheer waste of time.

Before the actual interview, the researcher must have sufficient "feel" of the problem. He must know what to ask and how to ask questions. The researcher must be able to distinguish between facts and opinions. He must discard cautiously the subjective bias of the interviewees. It is better to prepare before hand a list of questions that are to be asked. The questions should be problem-raising and problem-solving. However, when the knowledge of the researcher is very limited, he has to initially ask general questions on the subjects, followed by specific and pointed questions once some insight is achieved.

Case Study.* In a case study, a unit is at first studied and explored. The insight-stimulating cases should be selected for special study. For particular problems, certain cases may be found more appropriate than the others. The observations of strangers or foreigners may be very valuable, with reference to a certain community or culture. Likewise, the marginal individuals or groups can dramatically reveal the major features of the groups where they are mixing up. In a case study, the researcher himself has to be very alert. Under the case-study method, the subject-matter is studied in all its dimensions and ramifications. The researcher may take into account in this method, the transitional cases, pathological cases, complicated and simple cases and descriptions by foreigners and marginal individuals.

The aim of case study is to know precisely the factors and causes which explain the complex behavioural patterns of a unit and the place of the unit in its surrounding social milieu. It gives enough information about a person or a group or a unit. The case study method, mostly, studies the subject-matter qualitatively and covers all aspects of a single unit. The case study and the statistical method are, however, interdependent. Under the case study method, a subject is studied both horizontally and longitudinally. The primary need in this method is to know the manner and technique by which the subject-matter appears as an integral whole. The method aims at description as well as explanation of the unit it studies. It is both an intensive and an extensive study of a unit. It makes use of personal documents and case history. The method may be helpful in gaining experience, discovery of new facts and formulation of valid hypotheses.

However, it has to be noted that exploratory studies lead to insights and formulation of hypotheses; but the hypotheses are not tested in such studies. For testing hypotheses, we require more carefully controlled studies. Exploratory study is not simply interested in testing hypotheses as such. Its purpose is altogether different, as adumbrated earlier.

B. Descriptive and Diagnostic Studies

Descriptive and diagnostic studies are basically interested in detailed description of the phenomenon, group or community. The diagnostic study is concerned with discovering and testing certain variables with respect to their associations or dissociation. These two types of studies are not, strictly speaking, similar. A diagnostic study is concerned with an existing social problem and its basic nature and cause. The diagnostic design is concerned with the case as well as the treatment. The main objective of descriptive design is to acquire knowledge. There are certain areas where knowledge

*See also, Ch. 21 *infra*.

has not yet properly developed. In such a case, the investigator has to confine himself to descriptive design which is more useful than the diagnostic design.

Although there are differences between descriptive and diagnostic studies, they are very intimately related to each other. They share common requirements so far as study design is concerned. That is why we have included these two studies under one category of research design. These studies presuppose some prior knowledge of the problem that is being studied. The researcher must be able to clearly define what he wants to measure and describe. The major consideration in these studies is accuracy. Therefore, the research design for such studies must be such that bias can be minimised and reliability can be maximised. What is required in the matter of collection of evidence for these studies is flexibility.

The main objectives of these studies are to diagnose the problem, to accurately specify the characteristics, to determine the frequencies of significant variables and to find out whether certain variables are associated. The research design for these studies must be carefully planned so that subjective bias can be eliminated. The first step of the research design would be to objectively define the questions which are to be answered. It is necessary to adequately and scientifically define the involved concepts in an operational way so that the magnitude of the concept may be quantitatively measured.

The characteristics to be studied will depend on the main objective of the study. The primary step in drawing up a research design is to decide the objectives in detail. This will give a direction as to what type of data would be necessary to prove the case or reveal the characteristics.

Data Collection

After the objectives have been determined, the methods of data collection have to be specified or designed. There are three main methods of data collection :

1. The use of documents.
2. Observation.
3. Interviews or questionnaires.

The relevance of a particular method of data collection will depend on the objective of the study. For instance, if the objective is to know the attitudes towards family planning, it is better to utilise the interview method. Each one of these methods can be divided into many types, and somewhat different techniques may be used for different types. The researcher has to consider a number of things, such as the scope of the study, the type of information needed, the

degree of accuracy required, and so on, and on this basis, he has to select a proper method of data collection. The researcher must not ask a leading or a round about question. The sample chosen should be reasonably accurate with respect to representation. It is better to use random and matching samples. The researcher himself should supervise the staff of field workers who are engaged in data collection and recording.

Analysis and Interpretation*

The collected data must be properly processed and analysed. It has to be decided in the beginning whether the process of data collection would be a manual process or a mechanical process, and what types of tables are to be prepared. The nature and number of cross tables is also essential to determine. The purpose of a cross table is to find out the relationship between two variables. If the number of cross table is small, a manual method of data processing may serve the purpose, but if the number is large, a mechanical device for data processing may have to be introduced. The process of analysing the data includes coding the responses, i.e., placing the data according to their categories, tabulating the data and necessary statistical computations. Continuous supervision is necessary for properly coding the data. The statistical computations e.g. averaging, dispersion, correlation, etc. may be required according to purpose.

In the descriptive/diagnostic design, the basic structure and observational design remain rigid. Similarly, the sampling design, statistical design and operational design also remain rigid. The exploratory study on the other hand is more flexible in approach. But these are only general statements which may not practically conform to the real situations.

C. Experimental Design (Testing Causal Hypothesis)

Experimental design is concerned with making experiments to find out the cause-effect relationship of the phenomenon under study. Experimental study is also known as the study of causal relationship, whose main purpose is to test the causal hypothesis. It is considered to be the highest stage of social research. Science tries to explain the phenomenon, or to determine its causes. This can be done by testing the causal hypothesis. The experimental method not only reduces personal bias but it also helps to draw inferences about causality.

What is Cause?

According to J.S. Mill, cause is simply uniform antecedent. A cause is the invariable antecedent of an event. There may, of course, be plurality of causes. The knowledge of temporal priority is not

* See Ch.21, Section G.

in itself sufficient ground for inferring causality. Whatever goes before may not necessarily be the cause of whatever happens after. There may be many causes for an effect. In scientific research, we should determine the effect of particular variable. In order to do this, we isolate the effect of one variable at a time. We generally study the relationship between two variables at a time, by keeping other causative variables constant.

Experimentation

We should remember that an experiment is an observation under controlled conditions. When observation alone fails to disclose the factors that operate in a given problem, it is necessary for the scientist to resort to experimentation, for which controlled conditions are very essential. Controlling of conditions means that the phenomenon or the condition should not be allowed to change while the experimentation is going on. (See chapter on Observation and Experiment.) In experimentation, various types of evidence have to be collected so that alternative hypotheses can be tested, and causal relationship may be found out. There are many ways of inferring causal relationship among the two variables. J.S. Mill has discussed the following five methods (see, for detail, the chapter on Mill's Methods of Experimental Enquiry):

(i) *Method Agreement*. In this method, the two variables agree i.e. happening of X (cause) leads to happening of Y (event).

(ii) *Method of Difference*. This says that under two originally similar situations, the newly arising differentiating factor is the cause of the new phenomenon.

(iii) *Joint Method Agreement and Difference*. This shows that presence of X leads to Y, and the absence of X leads to the absence of Y.

(iv) *Method of Residue*. In this method, the process of elimination is applied. From the whole effect we deduct the known causes, and whatever is left is supposed to be due to the new cause or variable.

(v) *Method of Concomitant Variation*. In such a situation, when X (cause) increases, Y (effect) increases, but when X decreases, Y also decreases. Then, X is supposed to be the cause, and Y, the effect.

However, for establishing one variable as the cause and the other one as the effect, we must consider the *Time Order of Occurrence of Variables*. X can be the cause of Y if only X happens before Y happens. In other words, X must be the antecedent and Y must be the consequent. However, it must be noted that whatever happens before is not always necessarily the cause of whatever happens subsequently. For instance, suppose somebody starts singing, and after

a while another man falls senseless to the ground. Now, it cannot be said that singing is the cause of senselessness. Such a conclusion would lead to the fallacy of *Post hoc ergo propter hoc*.

In social research, we may come across a symmetrical relationship where the two factors may be simultaneously the cause as well as the effect. For instance, the higher the rank of a teacher, the greater is his knowledge pertaining to his subject. Here, the opposite is also found to be true. In such a case the question of "time order" becomes unimportant; but still, an effort may be made to know the more influential factor in a particular case.

Elimination of other Causal Factors

Since a phenomenon is caused by many factors, it is necessary to consider the effect of one variable at a time. Thus, one has to eliminate the effects of other variables for the time being. This can be done by the required *Experimental Design*.

Outline of an Experiment

The basic outline of an experiment is like the following: We choose two similar groups, one called the "experimental group" and the other "control group". The experimental group is exposed to the experiment being made. It is allowed to change by the acts of experiment. The "control group" is kept constant i.e. no change is made in it or no experiment is made on it. At the end of the experiment, we compare both the groups in order to find out the resultant effect of our experiment. Through experiment, we are able to control the effects of other possible variables. The difference between the two groups is considered to have been produced by the independent variable.

The causative factor can be regarded as an independent variable, and the effect is regarded as a dependent variable. But before the experimentation is started, it must be ensured that the two groups are similar in almost every respect. This can be taken care of by a fair and representative sampling technique. The main techniques for making the two groups similar are Randomization and Matching. In randomisation, no choice or preference is given either by the selector or by the selected: each unit or individual has a fair and equal chance of getting selected. The method of tossing a coin can be adopted for selecting a particular man in a group. But randomisation may not qualitatively ensure similarity between the two groups. Hence, matching. For matching, the population should be equally divided on the basis of the decisive quality or variable (for instance, intelligence, income, etc.). This will ensure equality between the two groups. Randomisation and matching should be done simultaneously. Another method of matching, known as *Frequency Distribution Control*, attempts to match an experimental group with

a control group in terms of the overall distribution of a given factor between the two groups. If 'age' is regarded decisive for the study, frequency distribution control would ensure that the average 'ages' in the two groups are alike, and the distribution of ages is similar in the two groups.

Types of Experimental Design³

There are mainly the following four types of experimental studies:

Experimental Studies

After-Only	Before-After	Ex-post facto	Panel Study
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After-Only Experimental Design. In this design, the experimental group and the control are similar. The uncontrolled external factors may affect both the groups equally. The experimental group is exposed to the assumed causal variable (X) but the control group is not exposed. After the experimentation is over, both groups are compared, and it may be noticed that some effect (Y) is produced in the experimental group, but not in control group. This X is regarded as the cause, and Y is regarded as the effect. In 'After-only' design, the two groups are assumed to be exactly similar.

This may not be true. Secondly, it is possible that Y is produced not by X, but by some other external factors, or by the joint interaction of X and other external factors. These are the two main limitations of this method.

Before-After Experimental Design. In this design, the dependent variable i.e. effect is measured both before and after the exposure of group/groups to experiment. This experiment may use one group or several groups. There may be one control group or more than one control groups. In the before-after experiment, the group/groups are measured or observed before the experiment and after the experiment, and the difference that is produced after the experiment is said to be the effect (Y) of the experimental variable (X). This design provides evidence of concomitant variation between X and Y, by making a comparison of Y in the group exposed to X with Y in the group not exposed to X. The second evidence of causality i.e. X coming before Y, can be inferred from the fact of randomization that the groups are similar with respect to Y. The equivalence with respect to Y at the outset can be ensured by the 'before' measures of the two groups.

When there are two groups—one experimental group and the other control group, both of them are measured at the beginning and also at the end of experimental period. However, experimental variable is introduced only in the experimental group. Since both

3. Vide, also, the Chapter on *Observation and Experiment*.

the groups are subject to "before measurement" and the uncontrolled factors, the difference between the two groups is regarded as the effect of the experimental variable alone (as shown in the following chart).

Condition	Experimental Group	Control Group
Before Measurement	Yes (Y_1)	Yes (Y_1)
Exposure to Experimental Variable	Yes	No
Exposure to Uncontrolled Factors	Yes	Yes
After Measurement	Yes (Y_2)	Yes (Y_2)
Change	$= Y_2 - Y_1$	$Y_2 - Y_1$

The greatest weakness of this design is that during the experiment, a group may be influenced by the external factor in a different way than the other group, for there is nothing to ensure uniform change. However, this design is more reliable than 'After-only' design. But the difficulty of finding exactly similar groups in all respects cannot be easily remedied. Even the "before measurement" technique may not be able to measure all the differences and common features in mathematical exactitude.

Ex-post facto Design: Sometimes it is not possible to divide population into two clear and similar groups. This may be the case where the entire society consisting of different varieties of people and conditions are involved. It may be necessary to study the entire historical background of a country. For instance, if a researcher is interested in studying the causes of a revolution which has already occurred, he will not be able to objectively study the exact situation that was prevailing before the revolution in the country. He has to depend on the historical background, and this will be studied through the *ex-post facto* experiment. In this particular case (revolution), the investigator should select two countries—one in which revolution has taken place and the other, where it has not. The countries, otherwise, should broadly be similar. Then, through a comparative study of the conditions of the two countries, the researcher may be able to find out the cause of revolution: In the *ex-post facto* study, past is studied through the present. But in other types of experiments, we try to prognosticate about the future from the present.

The most serious limitation of this method of study is the difficulty of finding out two similar groups or countries which are comparable. It is also very difficult to find out an objective criterion of comparability. Secondly, it is not possible to create artificial conditions or to have controlled conditions for study. In such a study,

"before-after" experiment is not possible. However, this type of study may throw considerable light on the causes of the present happenings by "raking up" the past.

Panel Study. Panel study is a method of study of a particular subject overtime by using different kinds of data. In this study, the researcher may secure direct evidence of time relationships among variables. It involves repeated observations on the same subject at different periods of time. In a sense, it is a type of time-series study. The common subject which is again and again observed and studied, constitutes a 'panel' for the researcher.

In the panel technique, the variation in the result may be attributed to a real change in the phenomenon. Panel study is continuous, thorough, deep and reliable. However, it has also many limitations, e.g., loss of panel members, non-representativeness, rigid attitudes of the members and so on.

Conclusion

Thus, we find that the experimental studies are affected by several limitations. Human society reveals inequalities in many respects, and it is also difficult to choose and find out homogeneous groups for experiments.

To sum up our discussion : A research design should contain detailed information about the (1) Topic of Research (2) Objectives, (3) Concepts and their operational definitions, or Variables, (4) Hypothesis, (5) Methods of Data Collection, (6) Method of Data Processing, (7) Analysis and Interpretation, (8) Time Dimension of the study and (9) Approximate Expenditure involved.

Collection and Analysis of Data

A : SOCIAL SURVEY

Definition of Social Survey

The term 'Survey' has come from two words, 'Sur' and 'Vor', which mean 'to see' a particular thing from a high place. But the term is used in different ways in different sciences. In Natural Sciences, it is used for measuring the things and in Social Sciences, it indicates the investigation of social problems, the technique of collection of data through interview, questionnaire, library or books etc. Many philosophers and scholars have defined the term in different ways. According to P.V. Young, "Social Surveys are concerned with (i) the formulation of a constructive programme of social reform and (ii) amelioration of current conditions of a social pathological nature, which have definite geographic limits and definite social implications and significance, (iii) these conditions can be measured and compared with situations which can be accepted as models." It is claimed that Young's definition of social survey is quite appropriate. Mark Abrams has defined social survey as a "process by which quantitative facts are collected about the social aspect of a community's position and activities." Hence, from the above definitions it is clear that social survey in a broad sense provides the basis for theory construction, and the implications for social planning and reform.

Objectives of Social Survey

Social surveys are motivated by a number of objectives which are enumerated below :

(1) *The Study of Social Problems.* The social survey is mainly concerned with social problems i.e. the problems of society and the economic and social problems of the human beings. Social survey aims at the removal of all socio-economic problems of the backward classes and underprivileged groups in the society. To bring about upliftment in society, social surveys are a prerequisite.

(2) *Test of Hypothesis Through the Collection of Data.* A hypothesis is always required to draw a conclusion. For this purpose, survey plays a crucial role. By collecting relevant data, a hypothesis can be proved or disproved.

(3) *Description and Explanation of Phenomena.* Through social survey, an investigator is able to collect the relevant data which in turn help the investigator to explain and describe the phenomenon in a better way.

(4) *Utilitarian and Practical.* The social survey is practical and utilitarian in nature. Social survey is undertaken for the welfare of society. All social surveys are undertaken from the practical point of view. From the result of social surveys, the government enacts various laws to protect the backward and poor classes against exploitation.

(5) *Data Collection Regarding Social Problem.* The first aim of a social survey is the collection of data and facts about certain aspects of a society or community. To achieve this an investigator or surveyor adopts various techniques. The data should be associated with the social problem of the concerned phenomenon or class. This survey may be either descriptive or statistical in nature.

Before conducting a social survey, it has to pass through various steps without which the result of so-called survey cannot become significant and reliable. The different stages in social survey are given below :

(1) *Definite Aim.* The aim and motive of social survey should be well-defined and clear. Clarity and definiteness of the problem is a *sine qua non* of any social survey.

(2) *Clarity of definition and of Problem :* The nature and the scope of the selected problem should be well-defined

(3) *Analysis and Explanation.* Every problem should be analysed and explained broadly and clearly, so that a detailed idea relating to the problem can be obtained.

(4) *Determination of Time-horizon.* Social survey involves a large amount of money and the services of numerous trained investigators. It is essential to determine a time limit for the survey. The surveys should be completed quickly within a short span of time. Otherwise, the results obtained may be suspect and the proposed solution may not be effective or relevant to the conditions of the society.

(5) *Determination of Techniques.* Before launching a survey, the technique should be ascertained. The determination of proper technique smoothen the survey and gives accuracy to the result.

(6) *Selection of Trained Researchers.* Before starting social survey, selection of well qualified and trained researchers is very essential. In selecting the researchers, the intellectual qualities of the researcher should be taken into account. A field worker has to deal with various types of persons. So a researcher should be very tactful and skilled.

(7) *Conclusion.* After collecting data, the collected material is classified and statistically analysed by competent and well-qualified researchers who at last draw conclusions from them. On the basis of these conclusions, government enacts laws and recommends some policy prescriptions to solve the problem.

Types of Social Surveys

Social surveys can be categorised according to their subject matter, scope and some other factors. In a broad sense, there are two types of surveys, i.e., general survey and specialised survey. General survey involves the study of the entire community in a general way. But a specialised survey means a study of some particular aspect of the community. Besides these two categories, the social survey can be classified in the following ways.

(1) *Regular and Ad Hoc Survey.* Regular survey is conducted after regular intervals. Generally, this survey is undertaken by the Government for obtaining certain facts and data about economic problems.

Ad hoc surveys are conducted for certain purposes and, are undertaken once-for-all. Mostly, these surveys are conducted for testing hypotheses or getting missing or new information.

(2) *Census or Sample Survey.* In a census survey, the entire population is studied. It is a time-consuming and very expensive method of survey. On the other hand, in a sample survey, a part of the population or unit is studied. It is less expensive and less time-consuming. But the validity of the result of this survey is not always universally true and up to the mark.

(3) *Primary or Secondary Survey.* The primary survey is conducted in order to acquire directly the relevant facts. This survey is more reliable than the secondary survey. Secondary survey is conducted after the primary survey has been completed.

Merits of Social Survey Method

Survey method is more reliable than any other methods. It has the following merits.

(1) A social survey throws useful light on the different aspects of social problems. On the basis of this survey, a constructive plan can be made for the development of the society.

(2) Through social survey, a solution to the problem can be made, effectively and easily.

(3) Social survey helps to build the foundation for the completion of a research project.

(4) Social survey helps to gather well-organised information on a particular problem.

(5) Social survey is more reliable than any other surveys, as it is quantitative in character.

(6) Through social survey, a researcher or an investigator comes in direct contact with the people from whom he collects the information. In this process, the new facts of life can be gathered, on the basis of which new theories can be developed.

Demerits of Social Survey Method

(1) The main drawback of this survey is that it involves a large amount of money.

(2) This survey is time-consuming.

(3) Data collected through this survey is not always reliable.

(4) Results obtained from the study become too general.

(5) Since this survey is conducted on sampling basis, it may involve 'sampling error'.

(6) Survey method does not take into account the historical perspective.

(7) The method emphasises only immediate problems.

Difference between Social Survey and Social Research

Social Survey and Social Research are almost similar. Both of them deal with social aspects of a society. Yet, there are some basic differences between the two methods which are classified below:

Social Survey	Social Research
1. The method is utilitarian in nature.	1. The method is scientific in nature.
2. A hypothesis is not necessarily required.	2. A hypothesis is very essential.
3. The method is concerned only with an immediate problem.	3. It is not concerned with immediate problem, rather its object is long-term research and problems.
4. It is concerned with particular aspect of a problem.	4. It is concerned with general problems.
5. The survey may be conducted on professional basis.	5. It is not usually conducted on professional basis.

Social Survey in Modern Times

In modern times, social survey has become scientific and well-organised. Social survey has become a part and parcel of many other social sciences, e.g., Economics, Psychology, Anthropology, etc. Nowadays, social survey is conducted by well-qualified, trained and well-experienced researchers. Social surveys by individuals or by private institutions have been abolished now. This is mainly due to the complicated nature of social problems. In recent times, social survey is conducted mostly by government organisations or by social institutions. The technique of the survey has become more developed and scientific in recent years.

B. CASE STUDY

Meaning and Definition

This is a very good method of collecting information about an individual, a family, or a group of persons. It is an intensive study through which one can know precisely the factors and causes of a particular phenomenon. It is a kind of qualitative analysis. According to P.V. Young, "case study is a method of exploring and analysing the life of a social unit, be it that a person, a family, an institution, cultural group or even entire community."

Characteristics of Case Study Method

(1) *The Study of the Whole Unit.* In this study, a large variety of units are selected for study and the size of the unit may be quite large to cover an entire community. In a word, this method treats an individual, an institution or a group of persons as a whole.

(2) *Intensive Study.* It aims at deep, and thorough study of a unit. It deals with every aspect of a unit and, studies it intensively.

Methods in Case Study

The following methods are undertaken in case study.

(i) *Determination of factors.* First of all, the collection of materials about each of the units or aspects is very essential. The determination of factors may be of two types, i.e., *Particular Factors* and *General Factors*.

(ii) *Statement of the Problem.* In this process, the defined problem is studied intensively and the data are classified into various classes.

(iii) *Analysis and Conclusion.* After classifying and studying the factors, an analysis is made, which in turn helps to draw conclusions.

Assumptions of Case Study Method

(a) *Totality of the Being.* In this method, the unit is studied as a whole.

(b) *Complexity of Social Phenomena.* Since the social problem is complex, a deeper study is required.

(c) *Time Factor.* Time factor has its impact on social phenomena. So a historical perspective of the problem is required for the study of the problem.

(d) *Underlying Unity.* It is generally seen that a unit may be representative of a group and can be studied as a type rather than as an individual. This characteristic of underlying unity helps the researcher to apply the inference or conclusion from a single unit to the unit as a whole or to other units.

Sources in Case Study Method

The following two major sources are applied in the case study method:

(i) *Personal documents.* From personal diaries, letters or from autobiographies, the necessary information is collected. The hidden secrets of an individual, his way of life, the objects and, the mode of life are written in one's personal diary. So personal documents can be a source of a great deal of information necessary for the study of the problem.

(ii) *Life History.* In the case study method the life history of a person may be very essential. This can be obtained through interview with the respondent. In this study, the entire life of the respondent is taken into account. The material for the case study can be also gathered from writing materials about the respondent and through interviews. Briefly, the entire life cycle of an individual is studied, tested and enquired in this type of case study.

Case Study Vs. Statistical Methods

Below we make a comparison between the case study method and the statistical method, by pointing out the similarities and differences.

Similarities

(1) The case study method also adopts the method to measure the central tendency as is done in statistical method.

(2) In the case study, the similarities or differences of certain cases are determined in the same way, as in the statistical methods where one tries to find out the correlations, codeviations and the

(3) The statistical method makes use of sampling as also the case study method.

(4) The case study method tries to find out the change of actions and reactions in the individual. This type of study is quite similar to statistical method when it measures the range of deviation.

Dissimilarities

- (1) The case study method is intensive in nature, whereas statistical method is extensive in nature.
- (2) The case study method is qualitative in nature. On the other hand, statistical method is quantitative in nature.
- (3) The statistical method only deals with the formal and general aspects of the subject; whereas, the case study method gives importance to emotional aspects of the subject-matter.
- (4) The generalisations in case study method are purely based on commonsense. But statistical method gives emphasis on mathematical treatment.

Importance of Case Study Method

Case study method has occupied an important place in the field of social research. Its merits and importance are enumerated below:

(1) *Intensive in Nature.* The case study method is intensive in nature. In this method various aspects of a unit or a problem are studied.

(2) *Gain of Knowledge.* Since the case study method is intensive in nature, a researcher gains through knowledge through this method.

(3) *Formulate valid Hypothesis.* The case study method helps to formulate a valid hypothesis. The method studies human nature and behaviour patterns very intensively. After studying the various aspects of life pattern, a researcher is able to formulate valid hypothesis.

(4) *Comprehensive Study.* The case study method deals with various aspects of the life of the individual. It is the only study which studies the life cycle from past to the present of an individual thoroughly.

(5) *Discovering Deviant Units.* The case study method helps to find out the deviant units which are marginal and are not compared with the amount of information yielded by general cases.

(6) *Subjective Study.* Since it deals with the psychological aspects of human life it is a subjective study. To eradicate social problems, this study is very essential.

(7) *Aid to Sampling.* The case study method is useful in Sampling, because it classifies the units efficiently on the basis of their qualifications and characteristics.

(8) *Useful in Framing Questionnaires.* The case study method is of immense value in making the questionnaires and schedules without which the peculiarities and characteristics of the individual or of the group cannot be studied.

Limitations of Case Study Method

The case study method has some limitations and difficulties. Due to these limitations, research work cannot be done properly. These limitations are given below:

(1) *False Sense of Confidence.* In case study method, a researcher becomes over-confident. Since he studies various aspects of the life of an individual, he thinks that he knows everything about that person. But it is seen very often that many other aspects of life were hidden about which the respondent himself was ignorant.

(2) *Difficulties in Collection of Historical Data.* Through this method, proper data collection is very difficult. This is because generally the respondents do not reveal the actual facts to the researchers.

(3) *False Generalisation.* Since it is not possible to collect proper data and information through this method, the generalisations on this basis become defective and faulty.

(4) *Expensive in Nature.* The time and money required for this study are sometimes prohibitive.

(5) *Possibility of Error.* There are many chances of making errors in selection of case, observation and so on, due to failures of the memory, suppression of unpleasant facts, tendency to exaggerate and the like.

(6) *Ad-hoc Theorising.* The explanation given through this method is unreliable because the case study method does not give importance to scientific explanation. It emphasises the commonsense explanation. Such explanations are hardly reliable.

(7) *Lack of Quantitative Study.* The case study method is qualitative in nature. It deals with only the psychological aspects of a human being. Quantification of the results is not possible in this type of study.

(8) *Unorganised and Unsystematic.* The method is unorganised and unsystematic, because there is no control on the researcher and on the respondent. Thus, verification is not possible. Hence, the data collected by this method is often unreliable and the generalisation drawn from it is also inaccurate.

Suggested Improvement

In spite of the drawbacks of the case study method, social scientists are in great need of this method for conducting their research. Many scientists have tried to put the method on more scientific lines. Among them are, Carl Rogers, Alfred Kinsey, John Dollard, Elton Mayo and many other eminent scientists. They have suggested some methods for the improvement of the case study method. They are as below :

- (1) The subject of study must be regarded as a specimen in a series of similar problems.
- (2) The life-history material should be organised and properly conceptualised.
- (3) In this method, the technique of elaboration of organic materials into social behaviour must be properly specified.
- (4) The method of action should be socially relevant.
- (5) The important role of any group or institution, which is responsible for transmitting a culture, should be recognised.
- (6) In a case study relating to individuals, the continuously related experience from childhood should be stressed.
- (7) The social situation should be specified as a part and parcel of the study.

Projective Technique

Projective techniques have recently been pressed into service in social research. In these techniques, the individual who is being observed or interviewed is not aware of the fact that he is being interviewed. This is so because the style of putting the question is not direct. He is indirectly brought into the main focus of analysis by means of some tests. For instance, he may be shown some ink blots of haphazard shapes or some photos, drawing, finger paintings and so on. Then, his reaction is studied, which can be very helpful for knowing his mental attitude, alertness, intelligence, thinking power and so on. There are many tests e.g., *Thematic Apperception Test (T.A.T.)*, *Picture Arrangement Test*, *Doll-Play Test*, *Sentence-Completion Test*, and so on. Apart from these, there are psychodramatic and sociodramatic techniques. All these can serve as the basis for studying the personality, sentiments and behaviour of individuals. Projective techniques are obviously objective. This technique is still in its infancy, and is being modified to make it more useful.

C: SAMPLING DESIGN

Meaning of Sampling

In a statistical inquiry, when only a part of the population or only a group of units is taken into consideration, it is called a *sample method of enquiry*. In statistical investigations, there is a long established practice by which a part of an aggregate is selected to represent the whole universe.

Statistical enquiries can be conducted by investigating only a small portion of the universe or every unit of the universe. The first method is known as sample method of enquiry and the second method is known as census method of enquiry.

Census Method

Census method is rarely used in the case of social phenomena. A census enquiry indicates the enquiry of the whole population or every unit of the entire field quantitatively. In a census enquiry, not a single item is left out. A census enquiry has many advantages which are enumerated below:

(1) In a census enquiry, a lot of information can be gathered. In this enquiry, the law of *Inertia of Large Numbers* is strictly followed. So, the results obtained are more or less accurate and correct.

(2) In a census, the entire universe is studied. The possibility of any bias or prejudice is minimum.

Like other theories, the census enquiry is also not free from drawbacks. The following are the disadvantages of census enquiry:

- (i) Census enquiry is expensive in nature. It requires a large amount of money and time.
- (ii) It requires a large number of enumerators who may not be always available.

Hence, a sample survey is better than the census enquiry, as sample survey requires a small number of enumerators who are easily available. With the help of efficient and better trained enumerators, the research can be conducted easily and the chance of error is relatively less. In researches in the educational, economic, commercial and scientific spheres, the sampling method is used and regarded as the best method because it involves less time, less resources and probably more accuracy. A sampling is easily manageable; whereas a census is a huge affair which seems to be beyond the competence of a single researcher.

Basis of Sampling

The selection of a sample as representative of the whole group

is based upon some assumptions which are given below:

- (1) The units or samples selected must have likeness or similarity with other units to make the sampling more scientific.
- (2) The sample should be such that it can represent adequately the whole data.
- (3) Each unit should be free to be included in the sample.
- (4) Absolute accuracy is not essential in the sample method. The results of the sampling method should be such that valid generalisations can be drawn.
- (5) The maximum amount of information must be gathered as accurately as possible.

Importance of Sampling in Social Research

The sampling method was used in social research as early as in 1754. A.L. Bowley first introduced the principle of random sampling in social research. Since then the method is increasingly being utilised in research. Nowadays, many a study is possible due to sampling.

The sampling technique is very widely used nowadays. Due to the following factors, it has occupied an important place in social research:

- (1) With the help of this method, a large number of units can be studied. When the area is very large, this method can be applied easily.
- (2) This method saves a lot of time, energy and money.
- (3) When all the units of an area are homogeneous, sampling technique is very useful.
- (4) Intensive study is possible through this method.
- (5) When the data are unlimited, the use of this method is very useful.
- (6) When cent per cent accuracy is not required, the use of sampling technique becomes inevitable.

Merits of Sampling

The merits of sampling are discussed below:

(1) *Organisational Facilities.* Sampling involves very few organisational problems as it is conducted by few enumerators.

(2) *Economy of time.* Sampling is less time-consuming than the census technique. It involves the study of smaller number of units which in turn saves time.

(3) *Economy of Resources.* Generally, sample study requires less money. The space and equipment required for this study are very small, for it involves the study of a smaller number of cases.

(4) *Accuracy.* Sampling ensures completeness and a high degree of accuracy due to a small area of operation.

(5) *Reliable Inferences.* The data collected by well-trained investigators on a sample basis are quite reliable.

(6) *Intensive in Nature.* Since the area of the study is quite small, a detailed and intensive study is possible through this method.

(7) *Vast Data.* When the number of units is very large, or the units are scattered, sampling technique is very useful, and can be conducted in a convenient manner.

Demerits of Sampling

(1) *Less Accuracy.* If the method of sampling is faulty, the conclusions derived from this become inaccurate.

(2) *Difficulties in Selecting a Representative Sample.* If the phenomena are of complex nature, the selection of representative sample is very difficult.

(3) *Changeability of Units.* If the units are not homogeneous, the sampling technique will be hazardous and unscientific.

(4) *Need for Specialised Knowledge.* The sampling technique becomes scientific and successful when it is done by specialised investigators. If this is done by ordinary people, the conclusions derived from this technique may be biased and sometimes entirely wrong.

Types of Sampling

The following are the main types of sampling generally used in social research:

(i) Random Sampling

In the random sampling, the individuals are selected from the population in such a way as to afford every individual of the population the same chance of being selected. The selection is entirely objective and is free from personal prejudice. But it is not haphazard and unplanned. Random sampling is made with the help of certain important methods which are discussed below:

The first common method is *Lottery Method*. In this method, the names of the individuals or units are written on slips of paper and they are put into a box. Then, the slips of paper are mixed thoroughly and some slips are picked up from the box. These papers are taken up for sampling. The second method is *Tippett's Numbers*.

This method was constructed by LHC Tippett. In this method, he prepared a list of 10400 four digit numbers written at random at every page. On the basis of these numbers, selection of samples becomes very easy. The third method is known as the *Grid System*. In this method a map of the entire area is drawn. Then a screen with squares is placed on the map and some of the squares are selected at random. Then the screen is put on the map and the areas falling within the selected squares are selected as samples. This method is generally used for selecting a sample of an area. The fourth and last method is *Selection from Sequential List*. In this method, the names of the units are arranged in numerical, geographical or alphabetical order. Then out of the list, any number is taken up.

At the time of drawing the random sample, some precautions should be taken. In random selection, utmost care must be taken so that the conclusion drawn from the sampling is accurate and reliable. The different units or items should be homogeneous so that the sample can be representative. Before random selection, the universe should be clearly defined, and the investigator should be well acquainted with the entire range of units or universe. In the random selection, the units must be independent of each other.

Advantages of Random Sampling

1. The random sampling method is more representative since in this method, each unit has equal chance to be selected.
2. There is no scope for bias and prejudices.
3. The method is very simple to use.
4. It is easy to find out the errors in this method.

Disadvantages of Random Sampling

1. If the units or items are widely dispersed, the selection of sample becomes impossible.
2. If the units or items are heterogeneous in nature or of different size and nature, the random sampling method becomes inapplicable.
3. Strictly speaking, the random sampling method is not very often possible. Instead of random selection, generally the investigator seeks chance selection.

(ii) Stratified Sampling

Under this system, the universe is divided into a number of groups or strata. Then certain numbers of items are taken from each group on random basis. At the time of constructing strata, certain points should be kept in mind.

- (i) There should be perfect homogeneity in the different units of strata.
- (ii) Stratification must be clear, well-defined and free from overlapping.
- (iii) The size of stratified sample must not be too small.
- (iv) Different variables involved in the study, should be taken into account.

Stratified sampling is divided into three main parts, i.e., (a) Proportionately stratified sampling, (b) Disproportionate stratified sampling, (c) Stratified weight sampling.

Proportionately Stratified Sampling. By this method, the number of units are drawn from each group or strata in the same proportion as they are in the universe.

Disproportionate Stratified Sampling. In this method, inter-strata comparison is possible. Under this system, the number of elements drawn from the strata is independent of the size of these strata.

Stratified Weight Sampling. In this system, equal number of items are selected from each group and thereby averages are drawn from each stratum. After doing this, they are given weights according to the size of the stratum in the whole universe.

Stratified sampling has certain merits and demerits.

Merits

1. By this method, a representative character can be obtained with a few number of items.
2. In this method, replacement of an inaccessible case by an accessible case is easily possible.
3. Under this system, no significant or important group is left out.
4. The method saves time and money, as most of the items or units can be geographically localised.

Demerits

1. It is difficult to put a particular case in a particular stratum.
2. If undue weight is given to the unit, the sample becomes unrepresentative.
3. When the sizes of different strata are unequal, attainment of correct proportion becomes very difficult.
4. If the strata are overlapping, bias may be caused.

(iii) Purposive Sampling

In this method, certain units are selected purposively for judgement by the researchers. In this selection, the researchers try to make the selection as representatives. In order to make the method successful, an investigator should be free from prejudices. The selector should select the relevant and representative samples as far as possible. The investigator should ensure that the frequency and the distribution of the sample are similar. The investigator should have the complete idea of the nature of the universe and various statistical measurements of it.

Merits

1. If this method is properly followed, a small sample can be representative.
2. In this method, a researcher has the final say on the selection.

Demerits

1. The selection is biased and prejudiced.
2. The results drawn are unscientific and inaccurate.

(iv) Quota Sampling

In this method, the entire data are divided into as many blocks as there are investigators. After that, the certain items are selected. This method allows freedom to the investigator. That is why this method is influenced by prejudices and bias. Due to this disadvantage, the method is sparingly used.

(v) Multi-stage Sampling

In this method, the items are selected in different stages at random. This method is applicable only where the universe is very large. In a sense, this method is a combination of random sampling and stratified sampling.

(vi) Convenience Sampling

In this method, the investigator selects certain items according to his convenience. No pre-planning is necessary for the selection of items. The method is applicable in those cases where the universe is not well-defined, sampling unit is not clear and a complete source list is not available.

(vii) Self-Selected Sample

In this method, the investigator does not select the samples or units. The samples offer themselves for selection. This method is

generally applied when the sampling area is not fixed.

Selection of a Sample

Proper selection of a sample is a very difficult task; but it is possible if some techniques are strictly followed. The following steps are generally adopted in selecting the sample.

(i) *Defining Universe*. The whole group from which the units or samples are selected is called 'universe'. Before selecting the sample, a clear idea of the universe is very essential. The universe can be divided into two types, such as, (1) Definite and Indefinite universe, and (2) Real and Hypothetical universe. When the number of units belong to the particular universe, it is called Definite universe, e.g., a particular area of a town. But when the number of units cannot be ascertained and the units continue to change, then it is called an Indefinite Universe, e.g., young babies. When the universe or the population actually exists, it is called *Real Universe*. Hypothetical universe indicates some attributes. This method is not used in the case of surveys. It is only used in statistical analysis.

(2) *Sampling Unit*. : Before selecting the sample, the units of the sample should be decided. The sampling units may be geographical, structural, social or individual. The unit should be definite, clear and unambiguous. The selected unit should be standardized as far as possible and it must be suitable for the problem under study. Only if the units consist of the above qualities, the sampling method becomes successful.

(3) *Source List*. It is a list which contains the names of the units of the universe from which the sample is drawn. If the list consists of the following qualities, then the sampling method becomes successful.

- (i) The list must be valid and up-to-date. Names of deceased persons must not be included in the list.
- (ii) The list must be reliable.
- (iii) The source list must be relevant to the study.
- (iv) There should not be repetition in the list.
- (v) The list should be exhaustive in nature. It must contain full information about the units. The addresses of the units must be written in the list.

Size of Sample

The size of sample plays an important role in sampling. According to Parten, "An optimum sample in survey is one which fulfils the requirements of efficiency, representativeness, reliability and flexibility". Hence, the sample must be small enough to avoid

unnecessary expenditure and large enough to avoid sample-error. The size of the sample depends upon a number of factors which are stated below:

(1) *Homogeneity or Heterogeneity.* If the population of universe is homogeneous, a small size of the sample may serve the purpose. But if the universe is heterogeneous, then the sample must be larger in size.

(2) *Number of Classes.* If the number of classes is large, the sample should also be large enough, so that every class must be of proper size for statistical analysis. On the other hand, if the number of classes is small, the small-sized sample is necessary.

(3) *Inertia of Large Numbers.* According to this law "Large aggregates are more stable than small". It means that the total change becomes very small when a large number of items are taken in a sample. This law presumes that the changes in the direction are neutralised by the changes in the opposite direction, and constancy is obtained. Hence, the larger the sample, the greater the accuracy.

(4) *Law of Statistical Regularity.* This law indicates that the samples must be random and representative of the whole universe. Only then, accurate results are obtained. Knowingly or unknowingly we make use of this law very frequently in our daily life.

(5) *Size of Questionnaire.* The size of the questionnaire or schedule plays a vital role on the size of the sample. If the questionnaire is small in size, the small-sized sample can serve the purpose. But if the schedule is large and the questions are difficult, the sample should be large in size.

(6) *Nature of Sampling.* If the cases are geographically scattered small sample is more suitable. If the selection of samples is done by the *Stratified Sampling Method*, the reliability and accuracy can be obtained by small-sized samples. Parten has given the following formula for calculating the size of the sample.

$$\text{Size of the sample} = \frac{\text{P.C.} (100 - \text{P.C.}) Z^2}{T^2}$$

Where, P.C. = Preliminary estimates of the percentage (from the universe).

Z = The number of standard error units which are found to correspond to the required probability.

T = The margin of error which may be tolerated (5% or 2%).

Parten has given another formula for calculating the sample size for estimating the mean of the universe in regard to a specified

characteristic, within a given margin of error with a given probability. The formula is given below:

$$\text{Sample Size} = \left(\frac{\delta Z}{T} \right)^2$$

- Where
- δ = Preliminary standard deviation of the universe.
 - Z = Number of standard error units corresponding to the required probability.
 - T = Margin of error to be tolerated.

We can conclude that nature of the problem, experience of the investigator and the commonsense of the researcher are the main guidelines for selecting the size of the sample.

Representative Sampling*

The foremost characteristic of any sample is its representativeness. Representativeness may be absolute or universal provided the sample is similar to the universe in all respects. But in the practical field, it is very difficult to find out two cases that are perfectly similar, especially in the case of social phenomena. But in spite of this difficulty, a researcher should find out the sample in which maximum degree of similarity can be obtained. Before selecting a sample, a researcher should take the following precautions:

- (i) The size of the sample must be large enough so that it can provide sufficient scope for various kinds of items to be selected.
- (ii) Sampling should not be done purposively.
- (iii) Sampling should not be done by perfect stratification method.
- (iv) The source list must be up-to-date and complete.
- (v) The field worker should not be prejudiced or biased at the time of selecting the sample.
- (vi) The unsuitable or improper method of drawing out the sample may cause bias. A researcher should carefully avoid this.

Reliability of Sampling:

The sample must always be reliable and representative in character. The valid generalisations can be achieved only when the sample becomes free from bias. Reliability of sample can be tested by some factors which are discussed below:

*See also, Ch 9

(i) *Size of Sample.* The size of sample should be adequately large.

(ii) *Homogeneity.* Reliability very much depends on homogeneity of the sample. Sample should be homogeneous which means that the sample should have all the characteristics that are present in the universe.

(iii) *Representativeness.* The sample should be representative in nature.

(iv) *Comparison of Sample and Universe.* If the different measurements of the universe are known, then the different measurements of the sample are compared with those of the universe and, if it is seen that the difference is very significant, the sample is considered to be biased or unrepresentative.

(v) *Probable Error.* This is a kind of measurement of unreliability. In the case of random sampling, the mean, standard deviation etc., differ from one sample to another. Such deviations can be measured by probable error. The error studies the difference between the actual values and expected values of an item. If the difference is greater then the chance of amount of error is also large. On the other hand, if the difference between the values is equal to zero, the probable error is also zero. We can, with the help of probable error, know how far an estimate is reliable. There is a close relationship between probable error and standard error. The probable error is 0.6745 times the standard error.

$$\text{Probable error of coefficient of correlation} = 0.6745 \frac{(1 - r^2)}{\sqrt{n}}$$

$$\text{Probable error of standard deviation} = \frac{.6745 \sigma}{\sqrt{n}}$$

[Where “—” indicates the standard deviation, “r” means coefficient of correlation and “n” stands for number of observations.]

Measures of reliability are concerned with fluctuations due to random sampling. Reliability of the measurement depends upon the number of cases in the sample and the variability of the values in the sample. The degree of variability of the cases in a sample has an important influence on the reliability of the measures drawn from the sample. This can be clearly understood from the method named standard error.

(vi) *Standard Error.* This method helps to find out by how much the estimated values differ from observed results. Greater the standard error, the greater is the deviation between actual and estimated values and greater is the unreliability of the sample. The standard deviation of a sample is known as ‘standard error’. If the difference

between estimated values and actual values is more than three times the standard error, the difference is said to be significant. The value of standard error varies inversely as the square root of number of items, and not in proportion of number of items. The relationship between the size of the sample and the variability of the items is indicated by the formula for the standard error of the mean. The standard error is a measure of reliability. It is estimated by the following formula:

$$\frac{\sigma}{x} = \frac{\sigma}{\sqrt{N-1}}$$

(vii) *Unbiased error.* In statistics, the word 'error' means difference between an estimate and the true value of the measurement. Unbiased error means the compensating errors. These errors arise in natural course of calculations. These errors are subject to the law of statistical regularity which means, as the numbers of observations, increase the unbiased error tends to decrease.

D: QUESTIONNAIRE

Definition

A questionnaire method is that method in which a number of printed questions is used for collecting data. This list of questions is sent by mail to the respondents. After filling up the questionnaire they return it to the investigator. The questionnaire method has been defined by different sociologists in different ways. According to Bogardus, "a questionnaire is a list of questions sent to a number of persons for them to answer. It secures standardised results that can be tabulated and treated statistically".

Purpose of Questionnaire

- (i) To collect information from the respondents who are scattered in a vast area.
- (ii) To achieve success in collecting reliable and dependable data.

Types of Questionnaire

P.V. Young has classified the questionnaires into two groups, i.e.,

- (i) Structured Questionnaires.
- (ii) Non-structured Questionnaires.

A *Structure Questionnaire* contains definite, concrete and pre-ordained questions. This type of questionnaire is prepared in advance and not on the spot during the questioning period. The structured questionnaires are used in a wide range of projects. The method is

used to initiate a formal enquiry and also to supplement and check data previously accumulated. These are mainly used in studies of economic and social problems, studies of administrative policies and changes, studies on the cost of living, consumer expenditures, public health and many other issues.

A *Non-structured questionnaire* is used as a guide at the time of interview. In this method, the interviewer is free to arrange the form and timing of enquiry. Flexibility is the main advantage of this method. This method is applied to studies of family group cohesiveness, to studies of personal experiences, beliefs, attitudes and the like.

The questionnaire is also divided into different types on the basis of nature of the questions. The various types are given below:

(i) Open (ii) Closed (iii) Mixed (iv) Pictorial.

The *open questionnaire* is used in cases where new facts are to be searched out. This method is mainly used for intensive studies of a limited number of cases. In this type, a respondent is free to express his views and ideas.

The *closed questionnaire* is used when categorised data are required. Here, the informant chooses the answer from a set of provided responses. He has no liberty to express his own judgement.

The *mixed questionnaire* consists of both close and open type questionnaires. For social research, this method is very useful.

In the *pictorial questionnaire*, pictures are used to promote interest in answering questions. It is used extensively in studies of social attitudes and prejudices in children.

Form of a Questionnaire

Proper size and form of a questionnaire plays a vital role in social research. Hence, before preparing a questionnaire, certain points are to be considered. These are the following :

1. *Size of Questionnaire.* The size of the questionnaire must be small and manageable.

2. *Appearance.* Good quality paper, attractive printing and layout have great importance in the questionnaire method.

3. *Clarity.* To obtain correct answers, the questions should be clear and precise. There should not be any ambiguity about the idea of the questions.

4. *Sequence.* The questions should be in proper sequence, lucid and interesting to the respondent.

5. *Margin.* A proper margin on one side gives a neat look to the questionnaire and it makes filling easy.

6. *Spacing.* The lines should not be very closely printed. Sufficient space should be left out to demarcate one question from the other.

7. *Length of Questions.* The questions must not be too lengthy.

8. *Technical Terms.* Technical terms as well as abbreviations should not be used in a questionnaire.

9. *Attractiveness.* The questionnaire should be formed in such a way as to attract the respondents quickly.

Characteristics of the Good Questionnaire

The preparation of a good questionnaire is a highly skilled art. The requisities of a good questionnaire are given below:

- (1) Analytical questions.
- (2) A lucid heading to the questionnaire, indicating the object and nature of the enquiry.
- (3) Clear and short questions.
- (4) Necessary instructions regarding filling-up the form must be given.
- (5) Limited number of questions.
- (6) Clarity.
- (7) Questions should be capable of being answered without prejudice.
- (8) The questions must be well arranged.
- (9) The questionnaire should be reasonable in size.
- (10) Emotional questions should be avoided.
- (11) Answers to the question should be corroborative in nature.
- (12) Answers to the questions should be objective and capable of tabulation.
- (13) Good presentation of schedule of questions.

Factors Affecting Response

Different factors are responsible for varying degree of response as stated below:

Characteristics of the group. The response normally differs according to the characteristics of the respondent group. Generally educated people are more responsive as compared to illiterate people.

Prestige of Sponsoring Body. If the institution has a good reputation, the percentage of response is very high.

Importance of the Problem. If the problem under study is important, a higher response is expected.

Nature of Questionnaire. If the get-up of the questionnaire is attractive, the respondents feel like responding quickly. Another important factor behind the response is that if the respondents are strongly in favour or against the concerned problem, a higher response is expected.

Size of Questionnaire. If the questions are small in number, the percentage of response is high.

Inducement for Response

Sometimes, the monetary inducement plays a vital role in getting a response. When the respondents get some inducement, they respond quickly. The inducements may be of many types, monetary or otherwise. In monetary inducement, some money is given to the people who are poor. Non-monetary inducements include a letter of appreciation, mentioning of the name of the respondent in the study and the like.

Follow-up System. In this method, successive reminders are sent at regular intervals requesting the respondents to send back the questionnaire as early as possible. Another method of ensuring replies is to send the questionnaire through mediators.

Reliability of Answers

The following factors affect the reliability of the response :

(i) If the questions are ambiguous in nature, the respondents are not able to answer them correctly.

(ii) The response through the questionnaire method may be unrepresentative in nature. The respondents who are not responding may belong to a particular class, resulting in the whole class going unrepresented.

(iii) The questionnaire method is inapplicable to uneducated persons. Hence, social problems cannot be studied through this method.

Test of Reliability

The reliability of the information obtained through questionnaire can be tested by following ways :

(i) The same questionnaire can be sent to the same persons after

a span of time. If the two replies are the same, the questionnaire can be said to be reliable.

- (ii) The same questionnaire can be tried on two similar samples. If the percentages of response are similar, the samples are to be regarded as reliable.
- (iii) If the majority of the questions are wrongly answered, then there must be something wrong either with the questions or with the respondents, or with both.
- (iv) If the answers are mutually contradictory, the questionnaire is said to be unreliable.

A draft of a model questionnaire is given below:

An Enquiry into the Financial Position of Private Colleges Affiliated to the University of Panjab

1. Faculty of Education

2. Name of the College

3. Address

Please give the answers to the following questions in the blank-space.

(a) Since when is the college affiliated to this University ? _____

(b) Is the affiliation permanent ? _____

(c) If not, what is the duration of the affiliation granted ? _____

(d) Is the college managed or owned by an individual or is it under any Trust or Committee ? _____

(e) Name of the Management : _____

(f) State whether the college has its own building or is hired on rent ? _____

(g) What are the total funds with the college ? _____

(h) What is the total number of students in the college ? _____

(i) Please give the following information:

(1) Total *Income* per annum as under :

Tuition fees	Admission fees	Library, Laboratory, Games fees	Miscellaneous income	Income through interest on capital fund	Total

(2) Total amount of *Grant* received by the college as :

Grant from the State Govt.	Grant from the U.G.C.	Other Grants and Aids

(3) Total expenditure per annum as :

Salary paid to teachers	Salary paid to Non-teaching Staff	Other expenses for the College Building	Miscellaneous Expenses	Total

- (4) Surplus Rs. _____ per Annum or
Deficit Rs. _____ per Annum.

Advantages of Questionnaire Method

The following are the advantages of questionnaire method :

- (1) The mailed questionnaire is popularly used when the field of research is vast and the respondents are scattered over a very large area.
- (2) The method is relatively cheap and expeditious.
- (3) By this method, a large sample may be drawn and all groups of people can easily be covered and contacted.
- (4) The method ensures anonymity.
- (5) Through this method, information is gathered at regular intervals.
- (6) The use of questionnaires is an impersonal technique.
- (7) The method places less pressure on the subject for immediate response, and gives more time to the respondents for properly answering questions.
- (8) Information obtained through this method is more valid and reliable.

Disadvantages of Questionnaire Method

The following are the disadvantages of questionnaire method:

- (1) If the respondents are non-cooperative, it is a sheer wastage of money and time.
- (2) The prejudices and biases of the researchers reduce the value of this method.
- (3) The method is inapplicable to illiterates.
- (4) It involves uncertainty about the response.
- (5) The information may not be correct and it is impossible to verify the accuracy.
- (6) Illegibility is another serious problem in this method.
- (7) If a problem requires deep and long study, it is not possible by this method.
- (8) Incomplete entries create a problem.
- (9) Due to lack of personal contact, the field workers cannot be certain about the validity of the information.

- (10) The respondents may not answer the questions correctly, or may not properly understand some questions.

To make this method successful, the following suggestions are made :

- (1) The questionnaire should be so framed that it does not place any undue burden on the respondents.
- (2) The sample should be sufficiently large.
- (3) Postage for responses must be prepaid.
- (4) It should be used in cases where there may be a legal compulsion to supply the correct information, so that the risk of non-response is eliminated.
- (5) The method should be adopted in cases where response is certain.

The Importance of Questionnaire Method

The questionnaire method occupies an important place in social research for various reasons which are enumerated below:

- (1) The questions which are included in the list of questionnaire are standardised. The questions are real and create interest to the informants.
- (2) This is an indirect method of collection of data.
- (3) By this method, a respondent acquires some knowledge about many fields that were unknown to him.
- (4) In this method, the researcher or investigator does not have to make any administrative arrangements.
- (5) The method is economical.
- (6) Through this method, a vast area and population can be studied easily.

E. SCHEDULE

The Meaning of Schedule

A schedule is a list of questions, which helps to collect data or requisite information. In this method, the investigator himself presents the questionnaire to the individuals whose responses are needed. According to Goode and Hatt, " 'Schedule' is the name usually applied to a set of questions which are asked and filled by an interviewer, in a face-to-face situation with another."

Both questionnaires and schedules are very similar; but they also

differ in some respects. A questionnaire is sent to the respondents by mail, whereas a schedule is used directly in interviews.

Features of Schedule

1. The list of questions is a mere document, so it need not be very attractive.
2. The schedule can be used in a limited area of research.
3. The schedule is put directly by the researcher and the answers are also noted down by him.

Objectives of Schedule

P.V. Young has laid great importance on the following aims of the schedule.

(i) *Delimitation of the topic.* In the schedule method, the data should be collected in an objective manner.

(ii) *Aid Memoire :* This method acts as a 'memory tickler'. A set of questions is prepared in a planned manner, and the researcher is always armed with the formal document containing the questions. So, if he forgets to ask some important questions, he may then take the help of the formally prepared document.

(iii) *Aid to Classification and analysis.* Through this method, the data are classified and analysed in a scientific manner.

Types of Schedules

According to P.V. Young, the schedule can be divided into the following four parts :

(1) *Observation Schedules.* These schedules contain some specific aspects on which the observer has to concentrate and collect information. With the help of these schedules, the observation becomes more accurate. This schedule serves many purposes i.e., it is a standardising device; it is a specific memory tickler, and it makes observation more accurate.

(2) *Document Schedules.* These schedules are used for recording data from case histories, documents, official records and so on. It is a very useful method for collecting preliminary data. Tabulations are made from these schedules either manually or mechanically.

(3) *Evaluation Schedules.* These schedules are used to gather information about some institutions or agencies. They help us to study their immediate problems.

(4) *Rating Schedules.* These are mainly used in sociological or psychological research. They are especially applicable in cases where

opinion, attitude and behaviour are to be measured. Through these schedules, different ranks or measures are prepared and rating is done on the basis of these.

(5) *Interview Schedules.* These schedules are used during interviews. Certain standard and specific questions are asked by the interviewer, and he has to fill up all the information obtained in the table.

Requisites of a Good Schedule

The following are the main characteristics of a good schedule, according to P.V. Young.

1. *Accurate Communication.* The basis of accurate communication is the proper wording of questions which are put to the respondents. The wording should be easily understood by the respondent. Only then can accurate information be received. Technical terms and ambiguity must be avoided.

2. *Accurate Response.* To achieve this, the schedule must be kept short. It must have an attractive form and style. The questions should be simple. The questions should be related to the concerned problem. Questions should be so constructed as to enable easy tabulation of the information gathered.

Construction of a Schedule

For constructing a good schedule, the following steps should be considered :

1. The investigator should have proper knowledge about the problem and he should know what information is required for a valid and accurate generalisation on each problem.

2. For collecting exact information, the questions must be complete, lucid and precise. They should be so framed that the respondents can easily grasp their meaning.

3. The physical design of the schedule plays a vital role in getting the information quickly. The schedule should be well-planned and good-looking.

4. It should be short, with proper margins.

5. The questions should be scientifically planned and should cover all relevant aspects of the problem concerned.

6. In order to obtain valid information, the questions should be placed in a well-ordered serial.

7. After the schedule has been prepared, it should be tested on a sample population. If there is any shortcoming, it must be remedied and the schedule tested again.

8. Good quality paper should be used.
9. The print should be easy to read and well-spaced.
10. If necessary, pictures may be used along with the questions to make the schedule attractive.

Contents of Schedule

The schedule is divided into three parts according to the nature of the contents. These are :

Introductory Part : In this part, the name of the survey, the address of the surveyor, serial number of the case, place of interview, date and time of the interview and so on are mentioned clearly.

Main Schedule : This is the main part of the schedule, consisting of titles, columns and questions.

Instructions : In this part, the researcher or interviewer is given directions regarding the method of interview.

Types of Questions

The questions of the schedule may be classified into the following :

(a) *Open-end Questions*. In these questions, the respondents are given freedom to express their views, as there is a wide range choice.

(b) *Closed Questions*. These types of questions do not allow the respondents to give answers freely.

(c) *Pictorial Questions*. In these type of questions, pictures are drawn, and the respondent indicates the answer by selecting the pictures he prefers.

(d) *Dichotomous Questions*. In these questions, two alternatives are given : a positive one and a negative one.

(e) *Multiple-Choice Questions*. These questions consist of many questions. The respondent has to select any one of these.

(f) *Leading Questions*. In these questions, the reply is suggested in an indirect way. These types of questions create confusion. Thus as far as possible, leading questions should be avoided.

(g) *Ambiguous Questions*. Questions which indicate alternate meanings and lack clarity are called ambiguous questions.

(h) *Ranking Items of Questions*. Through these questions, the preferences of the respondents are obtained.

Defective Questions

A question is regarded, defective if :

1. It is very lengthy.
2. If the nature of the question is indirect and ambiguous.
3. It is complex, and is regarding the personal life of a respondent.
4. It is suggestive.
5. A question that invites inaccuracy and unreliability.
6. It is superfluous to the problem at hand.
7. It is a question whose answers are universally accepted.
8. It contains abbreviations and technical terms.
9. It is addressed to the emotions of the respondent.

Merits of Schedule

1. In the schedule method, the answers are not biased as the field workers are personally present to remove any doubt.
2. The percentage of response is much higher in this method.
3. In the schedule method, a field worker is allowed to use abbreviations of the answers. So it saves time.
4. In schedule method, the field worker is able to find out the sampling defect and can also remove it.
5. Since the field worker comes in personal contact with the respondent through this method, it enables the field worker to probe more deeply into the character, living conditions, general life style and other necessary details about the respondent.
6. In the schedule method, the presence of the human element makes the situation attractive and interesting.

Demerits of Schedule Method

1. It is an expensive affair and covers only a small area.
2. It requires a large number of well-trained field workers, which in turn involves a great cost. Well-trained and experienced workers may not be easily available.
3. For conducting a survey through schedule method, elaborate administrative and organisational arrangements are necessary.
4. In some cases, the presence of the field worker creates a source of bias in the interview, since the opinion of the respondent may be influenced by the field worker.

Distinction between Schedule and Questionnaire

In an earlier section, we have discussed questionnaires. Apparently, the schedule and the questionnaire methods are similar. But there are also some differences between the two which may be discussed below :

Methodology : The schedule is a direct method. Here, the researcher comes in direct contact with the respondent, whereas in the questionnaire method, the data are collected indirectly through communications.

Types of Questions : In the schedule method, the questions that are included are very short. But the questionnaire method consists of rather lengthy questions, to get detailed information.

Reliability : The information that is collected through the schedule method is more reliable. But in questionnaire method, reliability is somewhat doubtful.

Area : The schedule method covers only a limited area, whereas the questionnaire method covers a wide area.

Clarification of Questions : In schedule method, an investigator can collect the information from uneducated people by clarifying the meaning and purpose of the question and study. But this is not possible in the questionnaire method.

Collection of Information : Through the schedule method, it is not possible to collect confidential information, whereas in questionnaire method, the respondent is free to express the actual fact.

Use in Sampling Method : Questionnaire method is not useful for sampling unlike the schedule, which is very useful for sampling.

Representativeness : The data collected through the questionnaires are not completely representative, since the investigator is not present before the respondent who has to give the information. The respondent may be unable to understand the meaning of the questions, and hence may not be able to answer correctly, as required. This problem does not arise in the schedule method.

Structure of Questions : In the questionnaire method, the questions are made on the basis of the cultural and educational background of the respondents. In a word, it is respondent-oriented. But the schedule method is just opposite to this.

F : INTERVIEW METHOD

Meaning

The interview method is a kind of verbal technique for obtaining data. It is the most commonly used method of data collection in the

study of human behaviour. It is a direct method of data collection. According to P.V. Young, "Interview may be regarded as a systematic method by which a person enters more or less imaginatively into the life of a comparative stranger."

Objectives of Interview

The objectives of interview are mainly of two kinds :

- (1) Laboratory study of verbal behavioural pattern under given circumstances.
- (2) Securing information from the person who alone knows the subject or the matter. Under these two headings, we can classify the objectives in the following way :
 - (1) Formulation of hypothesis.
 - (2) Collecting information about unknown facts through personal contact.
 - (3) Collecting information about qualitative facts
 - (4) Improving the method of observation.
 - (5) Collecting information about various problems in different circumstances.

Types of Interviews

The types of interviews may be classified on the basis of the grounds, as given in the following chart.

1. According to Subject Matter

According to the subject-matter, the interview may be divided into three types, i.e., (i) Quantitative interview, (ii) Qualitative interview (iii) Mixed interview.

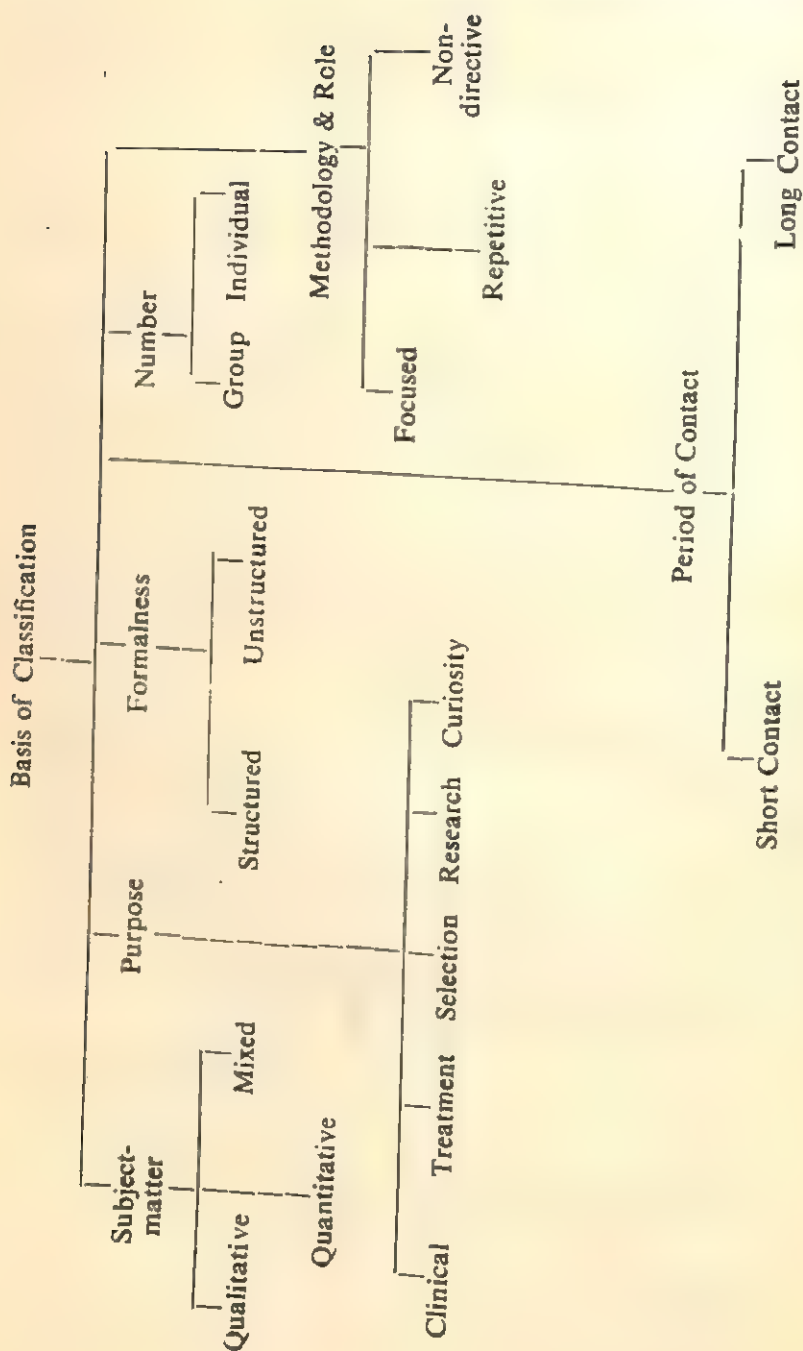
In the *Quantitative interview*, certain set facts are collected about a large number of persons, as in census.

A *Qualitative interview* consists of certain complex, serious and non-quantifiable subject-matter. This interview is confined exploring the causes of some events. Sometimes it is called *Diagnostic interview*.

A *Mixed interview* is a method where both types of data are required. Some of the data may be quantifiable and some not.

2. According to Purpose

Every interview is done with certain aim or purpose in view. According to the purpose of the interview, it may be classified into the types appearing on p. 225.



(i) *Clinical Interview* : Through this interview, the causes of certain abnormalities are ascertained.

(ii) *Treatment Interview*: This is a signal to the clinical interview caused after the abnormalities are ascertained.

Further interviews are held to know the actual cause of mental disorder of the particular patient.

(iii) *Selection Interview* : This interview is done to select an individual with some particular qualities.

(iv) *Interviews to Fulfil Curiosity* : Through these interviews, the interviewer fulfils his own curiosity, which lurks in his mind.

(v) *Research Interview* : This interview is done to collect information about certain problems to find out the truth.

3. According to Formalness

According to formalness, the interview can be divided into two main types : (i) Structured interview and (ii) Unstructured interview.

(i) *Structured Interview* : In this type of interview, a complete set of well-defined questions are used. In this method, highly standardized technique of recording are used. In structured interviews, generally even the alternative questions are fixed. Here the interviewer has to act according to the written instructions given in the schedule.

(ii) *Unstructured Interview* : In this interview, the interviewer does not follow a pre-planned list of questions. He enjoys full freedom to ask questions. He may revise the order of the questions to suit the needs of the respondents. In this type of interview, a deep knowledge and skill on the part of the researcher are necessary. In the opinion of Johan Gaultung, "The advantage of unstructured response is to be unprecise; that they permit the unexpected response "

4. According to Number

This category has been classified under two main types, i.e., (i) Group interview, (ii) Individual interview.

(i) *Group interview* : In this type of interview, a group of persons are interviewed for collecting information from them. This method economises both time and money.

(ii) *Individual Interview* : Here, a single individual is interviewed. Inter-personal contact between the interviewer and interviewee can be established.

5. According to Period of Contact

There are two types of interview on this basis i.e., short-contact

interview and long-contact interview. Sometimes, in social research, filling up of schedules or questionnaires, requires only a single sitting of small duration. For this type of job, a short-contact interview is the most useful method. But where the case history of an individual or a group of persons is required, prolonged-contact interview is necessary.

Besides the afore mentioned classifications of interviews P.V. Young has laid emphasis on the classification of interviews according to the role assumed by the interviewer and respondent at the time of interview. These classifications which are mainly based on methodology, are given below:

- (i) Focused interview.
- (ii) Repetitive interview.
- (iii) Non-directive interview.

(i) *Focused interview* : This method has been applied by R.K. Merton for studying the psychological effects of Radio, Cinema, Television, etc., on the public. The main purpose of this type of interview is to examine a particular hypothesis. In such interviews, the direction of the interview lies in the hands of the interviewer. Such interviews are based on pre-determined situations. This type of interview gives importance to the emotional feelings or attitudes of the individuals in a particular situation.

(ii) *Repetitive interview* : The main objective of this interview is to study the dynamic functions, attitudes and behaviour of certain individuals. For studying human behaviour, this method is very useful. This type of interview, requires that the respondents must be permanent residents of a particular locality so that they may be available for interview at any time. In a sense, it is a costly affair, since a permanent organisation has to be set up for this.

(iii) *Non-Directed interview* : There is no pre-planned set of questions, control or any direction in this method. In this method, an interviewer encourages the respondent to talk about the given topic without questioning him. For achieving the proper goal, the interviewer should create a suitable atmosphere in which the individual is able to speak freely and fearlessly about himself. In problems like divorce and social disorganisation, this method is very useful. This is the method by which a list of information about underground activities is collected.

Preparation for an Interview

Before undertaking an interview, the interviewer must prepare the ground in a scientific manner. The stages of prior preparation for an interview are as follows :

1. The investigator must understand the problem properly.
2. Before taking an interview, an interviewer must prepare the interview guide which gives an outline of the different aspects of the study. It may prove helpful in comparing data. It works as a "memory tickler."
3. An interviewer should approach an interviewee at a time when the person is free and in a relaxed mood.
4. The interviewer must seek a prior appointment with the respondents. If this is done, the interviewer may plan his own schedule accordingly.
5. Before undertaking an interview, an interviewer must gather the names, addresses and particular social habits of the respondents.
6. When the general outline is prepared, the cases which are to be interviewed have to be selected by various sampling methods. The selected cases must be available at the time of interview.
7. Before starting the interview, the interviewer must give his full introduction to the respondent.
8. For getting accurate information, the head of the family or the leader of the group should be interviewed.

Technique (Process) of Interview

1. First of all, the interviewer must give the introduction about himself to the respondent.
2. After giving the introduction, the interviewer should explain the nature and purpose of the research project.
3. The interviewer should create an atmosphere in which the interviewee can express himself freely.
4. The interviewer must prompt the memory of the interviewee.
5. The questions should be put in a systematic way, in lucid language.
6. Emotional and leading questions should be avoided as far as possible.
7. At the time of interview, the interviewer must jot down certain important points between brief pauses, between two questions, or he can record them with a tape-recorder.
8. When the respondent loses interest in the interview, the interviewer should try to recapture his interest.

9. The interview should not be closed abruptly. The interviewer must observe the situation carefully and give a natural end to the discussion. The most important points should be summed up just before closing the interview.
10. After the interview is over, the interviewer must write the report nicely and submit it as soon as possible.

Validity of Interview

Dr Komarovsky has suggested some precautions to avoid the errors in interview. These precautions are:

1. The interviewer must examine the cause and effect of the relevant aspects of the interview.
2. The researcher should examine data from other sources also.
3. The interviewer must know about the relatives of the respondent and their attitudes, towards him (the respondent). This is important in the study of personal problems, attitudes and relations.
4. The interviewer must try to collect extensive facts about the important aspects.

If a researcher follows these precautions, he may be able to draw an accurate conclusion.

Merits and Importance of the Interview

In social research, qualitative phenomena are not amenable to statistical analysis. In such cases, the interview is a very useful tool to gain insight. The following are the main advantages of the interview method:

- (a) An interview is a means of getting direct knowledge personally, and therefore, the information is reliable.
- (b) It is possible to study those phenomena which are not open to observation.
- (c) Through an interview, it is possible to study abstract factors like attitudes, feelings, opinions, reactions and so on.
- (d) It is possible to study the historical cases and past phenomena in an interview. The background of a case and the historical evidence can be best known from eye-witnesses and the observers.
- (e) The background, milieu and the internal aspects of a phenomenon can be classified in an interview.
- (f) Through an interview, one can learn the past, present and

likely future behaviour of human beings. The secret motivations, hidden desires and incentives working on human minds may be revealed by this method.

- (g) In interview, the inflow and outflow of information and knowledge may be mutually helpful to the interviewer as well as to the interviewee, and barriers in the flow of information are easily eliminated.
- (h) The information given by the interviewee may be tested through cross-examination, and emotional excesses and sentimental outbursts can be easily identified.
- (i) The method is highly flexible. New questions can be framed and cross-checking can be done under this method.
- (j) Direct interview eliminates personal barriers, brings each other very close, making the study more fruitful, thus giving an opportunity to study the immediate reaction of the interviewee. The interviewer acts as a catalyst, and he must learn to successfully handle delicate situations.

Demerits and Limitations of Interview

1. Interview yields subjective information which may or may not be true.
2. The method is not objective and scientific. It is difficult to verify the informations.
3. Personal factors, emotions and sentiments are many in interview, and as such, the real issue cannot often be known. The data may be unreliable and invalid.
4. Even by the interview method, the correct information may not be elicited by the interviewer. He may be biased, afraid, unwilling to reveal the truth, or may be emotionally over-ridden.
5. The interviewer may not be an expert either in the subject of study or in the art of interviewing, or in both. In such a case, an ideal result cannot be expected from the interview.
6. The method depends too much on memory and individual evaluation of the concerned problem, and the pride and prejudice of the interviewee.
7. The method is time-consuming, costly and subjective.
8. The personal things and highly delicate matters may not be revealed by this method.

These limitations, however, can be greatly reduced by the careful, trained, educated and experienced interviewer. A successful interview requires a proper study design, a friendly atmosphere, a positive

attitude, and unbiased and objective minds. The success of the method greatly depends on the personal qualities of the interviewer. The interviewer must be intelligent, shrewd, tactful, charming, objective, trained, well-mannered, cooperative, witty and well-versed in human psychology and intuition. According to P.V. Young, the limitations of the interview method can be overcome by:

- (a) Asking consistent and relevant questions.
- (b) Standardising the ways of asking questions.
- (c) Employing non-directive techniques.
- (d) Standardising ways of recording data.
- (e) Supplementing interviews with projective techniques where necessary (i.e., the respondent is given an opportunity to express his attitude and mind on certain selected situations, materials, or pictures).

The success of an interview depends to a great extent on successful communication between the interviewer and the interviewee. The establishment of a rapport between them is a *sine qua non* for a successful interview. It has to be borne in mind that an interview is an art.

G: ANALYSIS AND INTERPRETATION

Nature and Purpose

After the collection of research data, an analysis of the data and the interpretation of the results are necessary. Analysis of data comes prior to interpretation. But these two operations are so mixed up that they cannot be regarded as two separate operations. There is *something* more crucial than the facts and figures in research. The purpose of research is to find out that *something*. The purpose of analysis is to build up a sort of intellectual model where the relationships involved are carefully brought out so that some meaningful inferences can be drawn. Facts are never innocuous. They involve both subjective and objective elements. Facts and figures are to be seen in the perspective of objectivity.

Analysis of data is to be made with reference to the purpose of the study and its possible bearing on the scientific discovery.¹ An analysis is made with reference to the research problem at hand or the hypothesis. Some authors consider *processing* a necessary prerequisite for analysis. But many maintain that analysis of data involves processing. In other words, these two operations can be simultaneously made.

1. P.V. Young, op. cit., p. 473.

Analysis

The first step in the analysis of data is a critical examination of the assembled data. The researcher should ask himself questions. This stirs up his thinking process and might induce a novel way of looking at his problem and his materials. The analysis is made with a view to finding out some significance for a systematic theory and some basis for a broader generalisation. For analysing data, a *content-type analysis* proves helpful."

Analysis involves the verification of the hypothesis or the problem. Without proper analysis, data remain a meaningless heap of materials. Analysis involves the representation of the data, which can be done by *tabulation*. Secondly, analysis requires logical organisation of data; otherwise, logical results cannot be achieved.

Analysis involves many steps, e.g., categorisation, application of categories to the collected data, tabulation, statistical analysis and causal inference.

The researcher must properly classify his data into the required categories. The principle for classification has to be based on the problem under study or the hypothesis. For example, if the problem is the "extent of poverty", income, consumption, saving etc. may be the required categories. If "underemployment" is being studied, labour required, labour employed, intensity of work, actual yearly workdays, man-land ratios, wages and so on become the essential categories.

(ii) *Categorisation*: A proper set of categories must satisfy the following three conditions: (i) there should be a single classificatory principle, e.g., time of work, or income, or man-land ratio (for studying underemployment). However, this is a necessary condition and not a sufficient one. (ii) the categories must be exhaustive and sufficient for classifying all responses, and (iii) the different categories must be distinct, separate, and hence, mutually exclusive. The categories have to be independent and not overlapping. However, no complication is noticed in classifying the responses of "yes-no" or "favourable-unfavourable" varieties, but in complicated situations, classification cannot be based on a single principle.

It should be noted that the analysis of unstructured materials encounters many problems. In exploratory studies, where no formal hypothesis is formulated, there is no clear classificatory principle. However, a working or tentative hypothesis may be formulated in such cases, and classificatory principles may be evolved. But in practice, there are many missing links in exploratory studies. The materials may be missing or may be irrelevant. It is also objectively difficult to fix up the "units" against which the categories may be applied.

As soon as the categories are made, the next method of analysis of data is *coding*.

(ii) *Coding*: Coding involves the assigning of symbols (numericals) to each response of a category. The purpose of symbols is to translate raw data into symbols which may be counted and tabulated. The task of a coder is to give proper codes to the responses. The respondent himself is a coder when he is denoting his position in a particular class or category (e.g., unemployed or employed). Secondly, coding can be done by the observer or the interviewer at the time of data collection. Thirdly, the officially appointed coder may perform the job of coding.

There may be many difficulties in coding due to the inadequacies of data, inefficiency of the coder and lack of editing or scrutiny of the available data. *Editing* can be very helpful for coding and for the improvement of the quality of data collection.

(iii) *Tabulation*: Tabulation is a means of recording classification in a compact form in such a way as to facilitate comparisons and show the involved relations. It is an orderly arrangement of data in columns and rows. It is of great help in the analysis and interpretation of data. In tabulations, data are arranged in the forms of tables, for facilitating the statistical and mathematical operations. In tabulation, the purpose of study has to be always kept in mind.

(iv) *Statistical Analysis and Inference*:³ The analysis of survey material does not necessarily have to be statistical. However, more often than not social research requires the manipulations of statistical tools. Descriptive statistics is helpful to summarise the collected data, whereas sampling statistics can help in the making and evaluation of generalisations. Statistical analysis aims at working out various statistical measures helpful for analysis, e.g., central tendency (mean, median, mode), dispersion (range and deviations), correlations and so on.

One might start, if required, by constructing a *frequency distribution* to show how frequently an item or a thing occurs. When the distribution is perfectly symmetrical, it may become a case of *normal distribution*. The asymmetrical or *skewed distribution* may be either positive or negative. The characteristics of the whole group or sample may be found out by *Averages* which may be of many types (Geometric, harmonic and arithmetic mean) and, the researcher has to decide which is most suitable for his analysis. When the average figure of the series represents the entire series, it will be the value somewhere in the series where most of the items cluster or are centred together. Thus, the averages are called *measures*

3. The readers should consult some standard books of statistics for proper understanding and application.

of central tendency which include *mean*, *median* and *mode*⁴. One should consider how representative the average figure is.

Although the average value is the same, the variable may highly differ in magnitudes, making the average non-representative. To know the extent of variation, the researcher has to calculate measures of dispersion (*range*, *quartile deviation*, *mean deviation* and *standard deviation*). The *range* is the difference between the largest and the smallest sizes of the item. The *quartile deviation* is the difference between the upper and lower quartiles, divided by two. The *mean deviation* of a distribution is the arithmetic mean of the deviations of items from a measure of central tendency. The *standard deviation* is the most popular measure of dispersion. It is the square root of the average of the squares of deviations of individual items from their arithmetic mean.

A researcher might be interested in knowing the relationship between variables. The relationship between two attributes or qualities is studied by the technique of *association of attributes*. Whenever there is some definite linear connection between two or more variables, the variables are correlated. *Correlation* is positive if the two variables change in the same direction; it is negative, when they go in opposite direction. Correlation, however, does not necessarily point out any causal relationship. The extent of reliability of the calculated correlation can be known by estimating the *probable error* (see the section on *Sampling Design, supra*, in this chapter). In order to know the unknown values of a variable from the known values of another variable, a *regression analysis* can be made. Thus, one can know the most likely output of a particular crop "Y" relating to an independent variable, fertiliser "X". There may exist almost perfect correlation between two variables, but their proportional movements may be very high and different. Such proportionate differences may be known by calculating the *ratio of variation*.

The apparent variations in two samples may be due to chance or accident. This can be tested by *null hypothesis* which will be based on the notion that there is no variation apparently. By applying various statistical techniques known as *tests of significance* one can estimate the likelihood of the difference between the two samples by chance. There are many tests of significance out of which a researcher has to make his choice.

In a small sample (30 or less than 30 cases), the question of distribution of the variables becomes extremely important and the test of significance must be related to the proper distribution. When the series of "means" or "standard deviations" of the small samples may or may not be normally distributed, we may apply the "t" test

4. One should note that central tendency incorporates simple average (mean) median and mode. The *median* is the middle item of the series, and *mode* is the item which occurs most frequently in a series.

or "z" test or "F" test. *Chi-square* test is used to describe the magnitude of variation between theory and observation, or to test the hypothesis. If the value of chi-square is zero, it implies coincidence between observed and expected values.

The element of chance in selecting samples may be responsible for the difference between the two samples. What is the extent of the possibility of differences between two samples drawn from homogeneous and uniform population? This question can be answered by the null hypothesis. The null hypothesis reveals the chances of difference between two samples even if they are drawn from similar population. These chances may be 5 in 100 (.05), or 10 in 100 (.10) or 1 in 100 (.01) and so on. If the test of significance indicates that it is improbable that two samples differing to the extent (given) would be drawn from similar populations, then it is considered that the two populations are not similar. However, it should be noted that the tests of significance apply only to probability samples. The two samples may differ because the two populations from which they are drawn may also differ. This inference can be drawn if we can reject the null hypothesis. However, one may be wrong in rejecting the null hypothesis, for improbable things may also occur. It is sometimes wrong to accept the null hypothesis. Our statistical test of significance may indicate that sample differences have arisen out of chance even if the populations are similar. But this may not be true practically, for populations, in fact differ.

There may be many types of errors in statistical inference.⁵ Firstly, a hypothesis may be wrongly rejected and secondly, a hypothesis may be wrongly accepted. A statistical hypothesis may be at a particular level of significance (.10 or .50 or .01). The higher the level of significance, the better the hypothesis (thus 0.01 is better than 0.10). If we have already decided to work with 5% level of confidence, we may reject a hypothesis having a level of significance more than 0.05. But this decision itself may be arbitrary. A level of significance of 0.05 implies that the result is believable in 95 cases out of hundred. There is no rule as to what level of significance is necessary for the rejection or acceptance of a hypothesis. The criterion for rejecting the null hypothesis can be made very strict by raising the level of significance. In social research, a convention is developing which is in favour of rejecting a null hypothesis when the test indicates that the difference between the samples would not occur by chance more than 5 times out of hundred (if the chance of occurrence of this difference is more than 5 times out of 100, the null hypothesis may be accepted).

Another type of problem is related to the confidence limits for particular measures. For instance, if the mean income of a sample is Rs. 500/-, one may be interested in knowing the interval in which the

⁵ See the Chapter on Statistical Methods, and the section on *Sampling Design* in this Chapter (*supra*)

mean income of the parameter probably lies. This is expressed in terms of *confidence limits*. The calculation of this interval is not very often, precise.

The traditional analysis of statistical inference is based on the assumption of normal distribution. Recently distribution free non-parametric techniques have been evolved in *order statistics* for estimating parameters and testing hypothesis.

In social research, many a time, we have to study changes over a period of time. This type of study is known *time series* study where attempts are made to isolate secular trends, seasonal variations and irregular and cyclical fluctuations. The prime objective of time series analysis is to develop a more adequate understanding of the past and the present, and to forecast the nature of a given phenomenon.

A good judgement is essential in statistical analysis. Most of the serious errors in statistics are non-mathematical in nature, and mostly arise out of lack of appreciation, understanding and judgment. There may be errors arising out of data, mechanical mistakes and unsound interpretation. These should be carefully guarded against while making the analysis. It should be noted that statistical results are only probable results. Confidence in the result involves not only statistical confidence but also the validity of the presuppositions of research, and other available corroborative evidence and analysis. For instance, the absence of surplus labour may not be simply and adequately proved by the positive marginal productivity of labour. One may also show that wage and marginal value productivity are equal, peak shortage of labour is present and hiring of outside labour is practised on a large scale. It is not sufficient to interpret the result of research through statistical significance alone. A statistically significant result may have a very high, very low or almost insignificant social effect. Statistics is a bad master but it may prove to be a good servant.⁶

Analysis of Causal Relationship (Causal Inference)

In social research, the establishment of cause-effect relation in a clear-cut manner is really a difficult task. The statistical analysis must allow for the possibility of existence of a host of causes, and should try to discover the most important ones and their individual effects. The study of causal relation can be made through experimental design, as we have discussed earlier. But in social research, usually fully satisfactory experimentation is not possible. A social effect or phenomenon has complex varieties of factors as causes. It is easy but dangerous to follow a "one-track" explanation which leads to the cause.⁷ It is essential to look for a whole battery of

6. See *supra* the chapter on Statistical Method (Ch. 17).

7. P.V Young, *op. cit.*, p. 485.

causal factors or syndromes which are responsible for a social phenomenon. "No phenomenon", says Karl Pearson, "or stage in sequence has only cause; all antecedent stages are successive causes. When we scientifically state causes we are really describing the successive stages of a routine of experience."⁸

Paul Lazarsfeld has attempted to explain causal relation between two variables through his technique known as "discerning".⁹ It involves the following method:

- (a) Firstly, it is necessary to verify the alleged phenomenon. It is imperative to know whether the phenomenon is seen or experienced by someone. How does the phenomenon manifest itself and, under what conditions? What reason is advanced for the belief that there is a specific inter-connection between the two variables? How correct is the researcher's objective reasoning?
- (b) Examination is necessary to discover whether the alleged condition is consistent with the objective past facts.
- (c) One has to test the possible explanations for the observed phenomenon, or effect.
- (d) Rule out those explanations which are not in accord with the effect or phenomenon.

However, causal relation is very difficult to establish in non-experimental studies. In finding out the possible causal relation between two variables, X (cause) and Y (effect), it is necessary to follow a number of steps: (i) If Y has occurred before X, the possibility of causal connection may be ruled out. (ii) It has to be seen whether Y is influenced by variables other than X. This can be studied by introducing additional variables into the analysis and finding the relation between X and Y under the changed situation. If the prior relation between X and Y prevails, X can be regarded as the cause and Y, the effect. Supposing a new variable Z is introduced into the analysis, the following situations are possible:

Situation	New Variable	Relation between X and Y	Inference (Casual)
I	Z	Holds	X cause Y effect
II	Z	Stronger	Z is the contingent condition for causal connection

8. Karl Pearson, *The Grammar of Science*, p. 130.

9. P.V. Young, op. cit., p. 487.

III	Z	Weaker	(i) Either X is not the cause of Y (spurious relation)
		or Eliminate	(ii) Or, X leads to Y via Z Possible causal relation between Z and Y)

One may find a consistent relation between income and the number of children. It can be said by empirical observation that low income (X) is the cause of larger number of children (Y). However, further probing may bring out lower education (Z) as an important variable in this relation. If lower education (Z) is introduced in the analysis, it may be noticed that either the relation between low income (X) and larger number of children (Y) is reduced or is entirely eliminated. On the other hand, Z (lower education) may be found to have a better relationship with the larger number of children (say, Y). Thus, the relation between Z and Y may be considered to be genuine, while that between X and Y may be spurious. However, it must be ensured that Z is the antecedent and Y, the consequent, and no other factor has influenced Y. The time sequence of the variable is an important consideration for making a valid causal inference.¹⁰ It is necessary, however, to collect relevant data on all possible influential variables to study causal relation.

Interpretation

There is no clear-cut dividing line between analysis and interpretation. They very often overlap. Interpretation refers to the analysis of generalisations and results. Through interpretation, the meanings and implications of the study become clear. Analysis is not complete without interpretation; and interpretation cannot proceed without analysis. Both are, thus, inter-dependent. In fact, interpretation can be conceived of as a part of analysis. It is the task of interpretation to find out a link or a position of the study in the whole analytical framework. It connects the findings with the established theories or the available stock of knowledge in a particular area of research.

Interpretation analyses the abstract relations in more concrete terms, and tries to unfold the reasons for the existing type of relations or findings. It relates the empirical findings with the theoretical principles, and helps us to draw a number of useful inferences from the study. Although, chronologically, analysis and interpretation occupy the last stage of the research, conceptually or in terms of thought process, they occupy the first stage, since the necessary theoretical and practical knowledge of the future shape of the result is acquired much before the actual work is undertaken. The tools and techniques to be applied for the research

10. See, *supra*, the Chapter on *Research Design*.

have to be sharpened and made ready before the operation starts.

A research is not a simple fact-finding method : It is *something* more. It is the task of interpretation to successfully reveal that crucial *something*, as we have already pointed out. The interpretation takes the entire operation as a whole. The whole is more than the sum of its constituent parts. One can analyse the parts but he has to resort to interpretation for the whole.

The task of interpretation falls squarely on to the shoulders of the researcher himself. If he does not interpret his findings, others may interpret the findings in their own way subjectively, and misuse the findings of the study in some cases. While interpreting, the following common pitfalls should be carefully avoided :

- (a) Failing to consider all significant factors.
- (b) Ignoring negative evidence.
- (c) Mistaking correlation for causation.
- (d) Comparing non-comparable data.
- (e) Generalising from only a few cases (illicit generalisation).
- (f) Distorting interpretations to fit prejudice and preconceived ideas.

There is surely room in every research report for the research worker's own ideas and speculations. Sometimes, the findings have to be justified by giving a subjective interpretation. This is known as *Post Factum* interpretation. It is a flexible and less rigorous way of interpreting an event or fact. In the course of his work, the researcher should try to develop hunches and theories. Unsubstantiated assertions are neither infrequent nor small in scientific studies. But they should be carefully worded and should be used with some care.

The prime task of interpretation is to bring to the surface the real import of the findings. A researcher should explain why the findings are so, in objective terms. He should try to bring out the principles involved behind the observations. He can also make the reasonable predictions. On the basis of interpretation of an exploratory study, a new hypothesis can be formulated for experimental research. During interpretation, unconnected, isolated facts should not be discarded, but should be explained properly. Interpretation leads to the establishment of some explanatory concepts and principles, and the observed facts from a working model. A researcher's task is to identify and disengage such principles and processes. Interpretation can also provide a theoretical conception which can be the basis of further research and new knowledge. Thus,

continuity in research can be established and the quest for knowing the unknown can be sustained.

H : CONTENT ANALYSIS

Meaning and Nature

Content analysis is a systematic analysis and description of the content of communication media.¹ It is a specialised application of coding techniques. Books, journals, newspapers and the like may be analysed to study the changing attention to a particular issue over several years. Content analysis enables one to know the attitudes of the mass communication system towards a country, a system or an issue, whether national or international. Content analysis aims at scanning in a systematic manner the contents of communications. It has made possible the development of an elaborate technique for quantification of materials for research. Berelson has defined content analysis as "a research technique for the objective, systematic, and quantitative description of the manifest content of communication."² Content analysis is a technique of research for the systematic, objective and quantitative description of the content of research data procured through interviews, schedules, questionnaires and so on.

Content analysis is an attempt to convert symbolic behaviour into scientific data. It is a device of categorising or classifying research data according to the purpose of study: Research records can be subjected to various forms of content analysis. These are, according to McClelland: (i) interaction process analysis (ii) value analysis (various types of values in a society is the basis of classification), (iii) symbolic analysis (which analyses the latent meaning behind manifest content) and so on.

Content analysis has become significant after 1930's when Lasswell and his associates improved the technique in the study of communication content. In a content analysis, (i) the categories of analysis are clearly and explicitly defined, (ii) the classification should be objective and methodical and (iii) a quantitative method is used for measuring the importance of the content. The method or procedure of analysis is more important than the simple study of the character of data in a content analysis. This procedure has to be based on a technique of quantification which is the *sine qua non* of content analysis. The analysis wants to find out how the author or editor has treated a particular subject.

For content analysis, the first essential task is to define the universe of study. Then, the sampling problem has to be tackled.

1. Moser and Kalton, *Survey Methods in Social Investigation*, Heinmann Educational Books, London, 1971, p. 414
2. B. Berelson, *Content Analysis in Communication Research*, The Free Press of Glencoe, Inc., 1952, p. 18.

samples should be representative, and the size should be of manageable magnitude. It is necessary to specify the time period of content study. The sampling method in communication analysis must mention the sources of samples, samples dates (period covered) and sampling units (aspects of communication). The space devoted to the discussion of a particular issue in a newspaper or a book can also be taken as the basis of sampling for content analysis. The categories in terms of which the units can be classified may be based on the material itself and the objective of research. The primary method of increasing the reliability of classification is to specify clearly the characteristics of statements that are to be included in a given category. In a content analysis, the content of the communication is analysed by means of systematic, pre-determined categories based on themes, values, purpose and so on, which often yield quantitative results.

Purpose and Use

The most elaborate work on the content analysis of newspapers has been done, among others, by H.D. Lasswell and his associates. He developed the "symbol analysis". According to this, certain symbols, e.g., "democracy", "socialism", "Stalin" and so on were studied with reference to their frequencies and attitudes towards them (favourable, unfavourable or neutral). Davidson's analysis of Berlin newspapers was based on the names of countries and the themes. He developed the thematic type of content analysis. The contents, needless to add, can be studied itemwise or countrywise. Wright and Nelson employed another type of content analysis which studied the representative statements of newspapers concerning Japan and China.

Content analysis can be used to study the attitudes of persons or the press on certain important issues, like, racial prejudice, prohibition, international relations, development policy. The speeches and propaganda of politicians and diplomats can be subjected to content analysis. R.K. White's content analysis of the public speeches of Hitler and Roosevelt revealed that these two leaders appealed to the public by means of the references of three values—strength values, economic values and moral values.

The ultimate purpose of content analysis is to help the testing of hypotheses by providing necessary quantitative data. Content analysis provides definite and objective answer in lieu of judgements or impressions. The analysis is objective and systematic, and leads to more reliable results. Modern content analysis has added a new dimension to the exploitation of communication content, for the purpose of research. It aims at developing an elaborate technique for the quantification of materials and thereby helps the proper coding of data. The analysis is immensely helpful in the classification

and organisation of data. The purposes of content analysis may be the following.³

- (a) To identify the motive of the communicators.
- (b) To detect the existence of propaganda.
- (c) To obtain political intelligence.
- (d) To identify psychological attitudes.
- (e) To propagate or destroy a value, system or attitude.
- (f) To describe attitudinal and behavioural responses of the communicators.
- (g) To describe the communication trends.
- (h) To trace the development of ideas or theories or empirical facts.
- (i) To compare different communication systems or agents.
- (j) To compare communication content *vis-a-vis* objectives.
- (k) To reveal international differences in communication systems.
- (l) To construct and apply communication standards.
- (m) To discover prevailing trends and features.
- (n) To expose the propaganda method.
- (o) To measure the readability of communication materials.
- (p) To help research.

According to L. Festinger and Daniel Katz, content analysis aims at converting recorded raw phenomena into data which can be treated essentially in a scientific manner so that a system of knowledge may be built up. Content analysis can create reproducible or objective data which can be quantitatively measured and which can be significant for scientific theorising.

Problems and Limitations

(i) In content analysis, the procedure of analysis is regarded as more important than the content of communication. This robs the meaning of the content analysis.

(ii) The analysis over-emphasises the need for quantification. It is not clear why quantification is to be treated as more important than the content. It is also not specified as to how to quantify the information. Quantification of information is not always feasible.

(iii) Sampling for content analysis may not be perfect and accurate. How does one select say a newspaper sample? What should

be the size of the sample? What should be the ideal time period of study? All these are very relevant questions which cannot be precisely and adequately answered.

(iv) Different communicators explain or analyse a problem with different criteria or references. Then, which one is to be considered as relevant for content analysis? What should be the basis of the analysis and method of interpretation? This problem has not been satisfactorily dealt with in content analysis. The method of analysis remains vague.

(v) Sometimes it is very difficult to objectively and adequately define a category (say, *safety*). Therefore, categorisation, which is the basis of content analysis, remains imperfect and incomplete.

(vi) The information contained in a communication is qualitative in nature. This cannot necessarily be converted into quantitative data by simply noting the frequency of occurrence of a symbol or word. The quantification may not be objective, and as such, may not be reliable. Frequency of occurrence of a word or symbol cannot be the basis of reliability, because the same word or symbol carries different meanings in different contexts. Again, if the definitions of a category are different, the category cannot be said to be a reliable basis.

The coders should be trained and experienced. The efficiency of the persons who perform the job of coding is very much responsible for the reliability of content analysis. In the words of Selltitz, Jahoda, Deutsch and Cook, "To increase reliability of content analysis there is no other way but patient experimentation with refinement of definitions and careful training of the persons entrusted with their use in classifying the data."⁴

I RESEARCH REPORT

Purpose

Presentation of research findings in the form of a report (thesis or monograph) is a necessary part of the research process. The main purpose of report is to convey to the interested persons, the empiricists or the theoreticians the whole result of the study in sufficient details, so that new finding or new methods of analysis can be incorporated into the general store of knowledge available in the area. A report is the detailed description of what has been done and how it has been done with respect to a particular area or topic or research. [A report may be meant for the general readers, or the evaluators or for the sponsors of the research.] A report may also be addressed to the experts in the field for a critical exa-

4. *ibid.*, p. 342.

mination of the achievements made, if any, for the purpose of keeping alive the spirit of enquiry. The purpose of a report is the dissipation of knowledge, broadcasting of generalisation and helping further research in the related field. A research report may be helpful to throw some new light which can make the building up of a new hypothesis and thus can make possible new theorizing.

While writing the research report it is very essential to keep in mind the level of knowledge of the readers. A report written for expert evaluators or scientists or a specialised institution must be more rigorous more detailed than what is written for the general readers. There may be various types of research reports, e.g., thesis monograph, journal article and so on. Because of the spatial limitations and selectivity, a journal article cannot discuss every aspect of the research in details, as can be done in a thesis. We are here mainly concerned with the method of writing of thesis or monograph. However, shorter papers or articles may, in some cases, follow the same technique with somewhat different emphasis on style. The editorial style of writing journal papers varies from journal to journal. Hence, before finally preparing a paper, the scholar can ask for a style sheet of the concerned journal. The style of the thesis writing, particularly the editorial aspect, may not be the same everywhere, but by and large, a pattern emerges, as we shall see.

Contents of the Report

A report contains the following aspects of research.¹

(1) The title of the topic should be clear and suggestive. It is necessary to have a clear statement of the problem on which research is to be done.

(2) It is necessary to indicate why the problem under study was considered worth investigating. In other words, the purpose, rationale and scope of the study should be clearly indicated. All these can be discussed in the introductory chapter which may also include the methodology and research procedures followed in the study. Methodology should clearly specify the method of data collection, the analytical design, and the mathematical/statistical techniques that have been employed for finding out the results. It is concerned with the "how-to-do" question, as the statement of the problem is concerned with the "what-to-do" aspect. These two should be consistent. The introduction should also give a plan of study by preparing a chapter scheme. The introductory chapter may also mention the background information by relating the present study with the earlier ones. The necessary historical background or review of literature may be presented in the introductory chapter. The limitations of the study may be presented either in the "introduction" or at the

1. A researcher should read a few theses to get acquainted with the style and technique of writing.

end of the thesis under a sub-heading, "Limitations of the Study".

(3) In the First Chapter, the concepts which have been used in the study should be clearly defined, and the new conceptualisation and its operational definition should be clearly stated. Some experts are in favour of giving the hypothesis in this chapter alongwith the method of testing the hypothesis. However, the formulation of the hypothesis and its testing may be discussed in a separate chapter.

The subsequent chapters should be based on the plan of the study already prepared. There is no hard and fast rule about chapter scheme. In general, every chapter should deal with a particular idea, which forms a related segment of the entire construct of the thesis. The chapters should be well-balanced, mutually related and arranged in a logical sequence, to naturally lead to the derived conclusions.

(4) In the chapter on Conclusions, the main findings of the study can be presented systematically, and the limitations of the study may be discussed here, if not already mentioned. It is important to make known the negative results just as the positive ones. If the result is against the hypothesis, it should be clearly stated. The inconclusive results may be useful for further research and hence, have to be stated.

The implications of the study for society, the administrators and the authorities should be thoroughly discussed. It is very essential to unfold carefully theoretical, practical and the policy implications of a social research. The researcher must bring into focus the relevant questions that are still unanswered and the new questions raised by the study. A good study must raise some new issues and new questions and provide some suggestions for the kind of research that would help to answer them.

(5) It is customary to conclude with a brief resume or summary, restating the whole performance all over again briefly and incisively. This may be taken as the abstract of the entire work.

(6) It may be necessary to include the appendices like sample questionnaires, transcription sheets, sample interviews and so on.

(7) Selected bibliographical references may be very useful to gauge the content, the seriousness of the study, and the awareness of the researcher. In the case of a short paper, a short list of references used can serve the purpose.

Some General Remarks on Style and Presentation

As mentioned earlier, there is no unique and universally acceptable method of writing a research report. Much will depend on the topic of research, the degree of sophistication introduced, the type and extent of the materials and the techniques introduced, and above all, the acumen, skill and the imagination of the researcher. In the

matter of writing, no two researchers are alike so far as style and presentation schemes are concerned.

A research report is essentially a scientific document, and hence must be clear, accurate and precise. Confusion, ambiguity, pretentiousness and pomposity must be carefully guarded against by a researcher. A research report is not the area of blooming 'Johnsonian verbosity' and confusion. To quote from a work on Sociology:

"These concepts can hold only for ranges of variation of circumstances not too large to invalidate the assumption that for practical purposes, the particular constant relations between the values of analytical elements which these type concepts in the concrete case represent, will not be so unreal as to exceed an acceptable margin of error."²

Needless to say, such a style of writing a scientific document is utterly confusing and unintelligible. Therefore, should be carefully avoided. It is sometimes necessary to translate technicalities into language that would be understood by the readers. This is especially necessary when the report is meant for the general public. However, a report meant for experts may very well contain technicalities.

The very sensitive aspect of a report is its language. An ideal language and style, however, cannot be formally taught, but one has to acquire them by experience, intuition, care and practice. Generally speaking, the emphasis should be on clarity, correct exposition, expression and, simplicity. There is no substitute for simplicity. The researcher should always try to use not the almost appropriate word or expression but the exactly appropriate one. The difference between the appropriate word and almost appropriate word is the difference between lightning and lightning bug. A very lengthy report may not be very scientific. If one has time at ones disposal, a lengthy report should be made shorter. A research scholar must essentially know a good bit of editing. He must have sufficient control over the language, its literature, grammar and composition. A style that is pleasing from a literary or aesthetic point of view is an additional quality of a researcher; but he has no obligation to be colourful or elegant in his writing.

The report should be free from subjective bias. The result should be objectively presented in a balanced way. Repetition of facts and statements has to be eliminated at any cost. The presentation of the facts must be logical. The very common logical fallacies, e.g., *petitio principii*, *post hoc ergo propter hoc*, *non sequitur* and the like may creep unknowingly in the arguments. A researcher must be able to detect and eliminate them. In this regard, a knowledge of deduc-

2. Quoted by Goode and Hatt, *Methods in Social Research*, McGraw-Hill, New York, 1952, p. 366.

tive and inductive logic is an additional advantage to a writer. Since logic is the basis of all sciences, a researcher must have a knowledge of logical principles.

While writing the report, the relevant diagrams, graphs, tables and charts should be properly placed so that they become immediately a part of the texts where they are placed. They should have appropriate titles and dimensions. Tables and diagrams should be numbered, and where necessary, the sources of tabulated data should be specifically mentioned. If relevant, in the body of the tables, approximate values of the standard errors and the levels of significance should be mentioned. Ideally, standard error figures should be quoted for two or three confidence levels, so that the reader can make his choice. However, if the report is meant for laymen, these technicalities are better left unmentioned.

The report should be presented in an attractive form i.e., typing should be accurate, neat and clean and with sufficient margins on all sides of the typed paper. The paper should be suitable for the purpose. The report must make use of sub-headings at appropriate places of discussion.

For referring to quotations and used works, and for clarifying meanings, foot-notes are to be used in a report. They can be consecutively numbered, and explained at the bottom margin of the relevant page. By convention, the books and journals cited in the footnotes and in the bibliography are underlined. In the event of the publication of the report, the underlined portions are printed in italics. For saving space and time, different abbreviations are used in foot-notes, e.g., 'Ibid', 'Op. cit', 'loc. cit.', and so on. When same reference as the immediately earlier one is to be used, "ibid" can be written; when a reference which has been mentioned somewhere earlier in the report is to be mentioned again, one can write instead, "op. cit"; "loc. cit" is used when material is drawn from the same passage or page of the same book. The general style of foot-noting is as follows:

While writing footnotes, the names of the articles/research papers are kept, by convention, within inverted commas ("....."). In book references, the name of the writer, is followed by the name of his/her work; then come the name of the publisher, place and year of publication and the relevant page number. In the case of articles, the name of the publishing journal and year and month of publication are to be mentioned. When there are many writers, one can use "*et al.*" (others) after one author. In case a particular idea or statement is given at many places in a work, the researcher can simply use the expression "*et passim*" to suggest this fact.

It is advisable to prepare a first draft of the report for critical considerations and possible amendments. Drafting is an art. The first draft has to be critically scanned by the researcher himself and,

if possible, by other experts in the field. The experts can give their suggestions and constructive comments in the light of which the report can be finally amended, retyped and presented. The process of self-criticism has to be thorough and critical, and through this, it is always possible to find some better expressions, more appropriate words and clearer method of exposition.

Thus, basically there are three problems in writing: (i) how to begin (2) how to carry on and (3) how to come to a close. A good writer, like a good artist, must know where to end. One minor point. One should carefully learn to use proper adjectives. The more the adjectives, the higher is the emotional state, which is said to be the enemy of a scientific mind. A passage may appear to be very beautiful to the writer, but to others, its meaning may not be very clear. In such a case, it is better to rewrite the whole thing once again. Dr Johnson once quoted a college tutor who used to tell his students: "Read over your compositions, and, whenever you meet with a passage which you think is particularly fine, strike it out". In conclusion we must state that one particular rule for writing, which should be explicitly stated, is that there is no explicit rule for writing.

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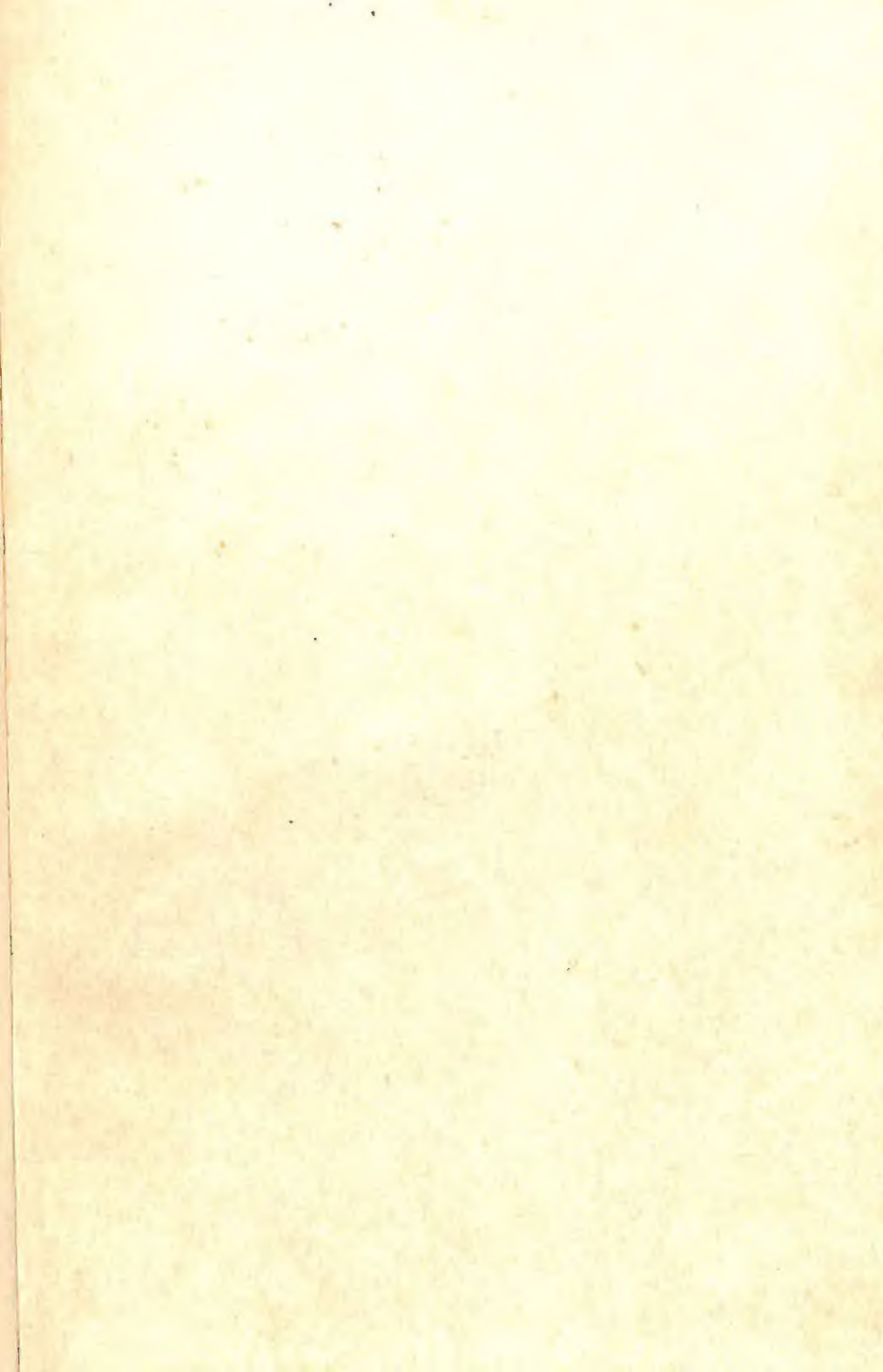
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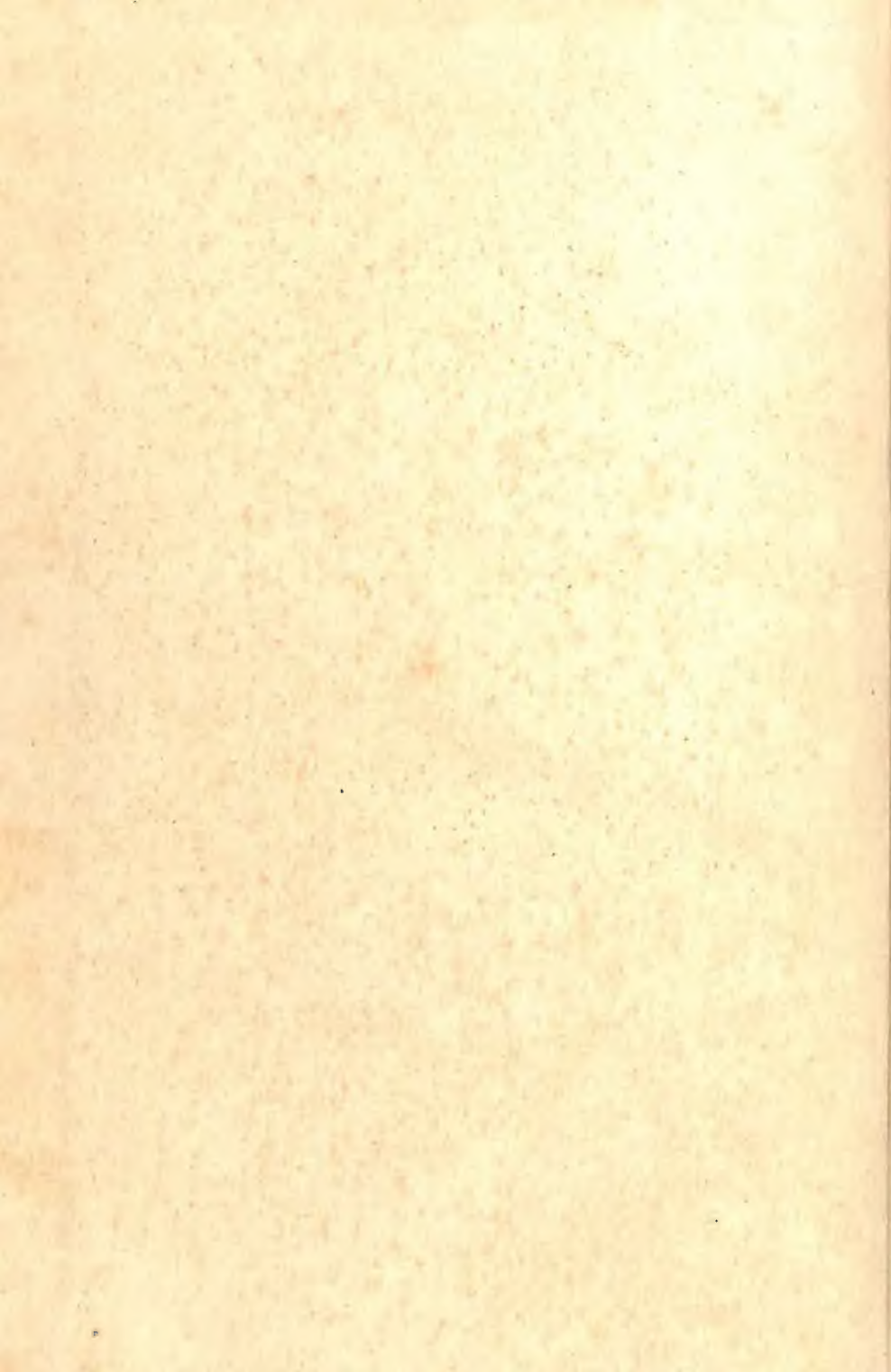
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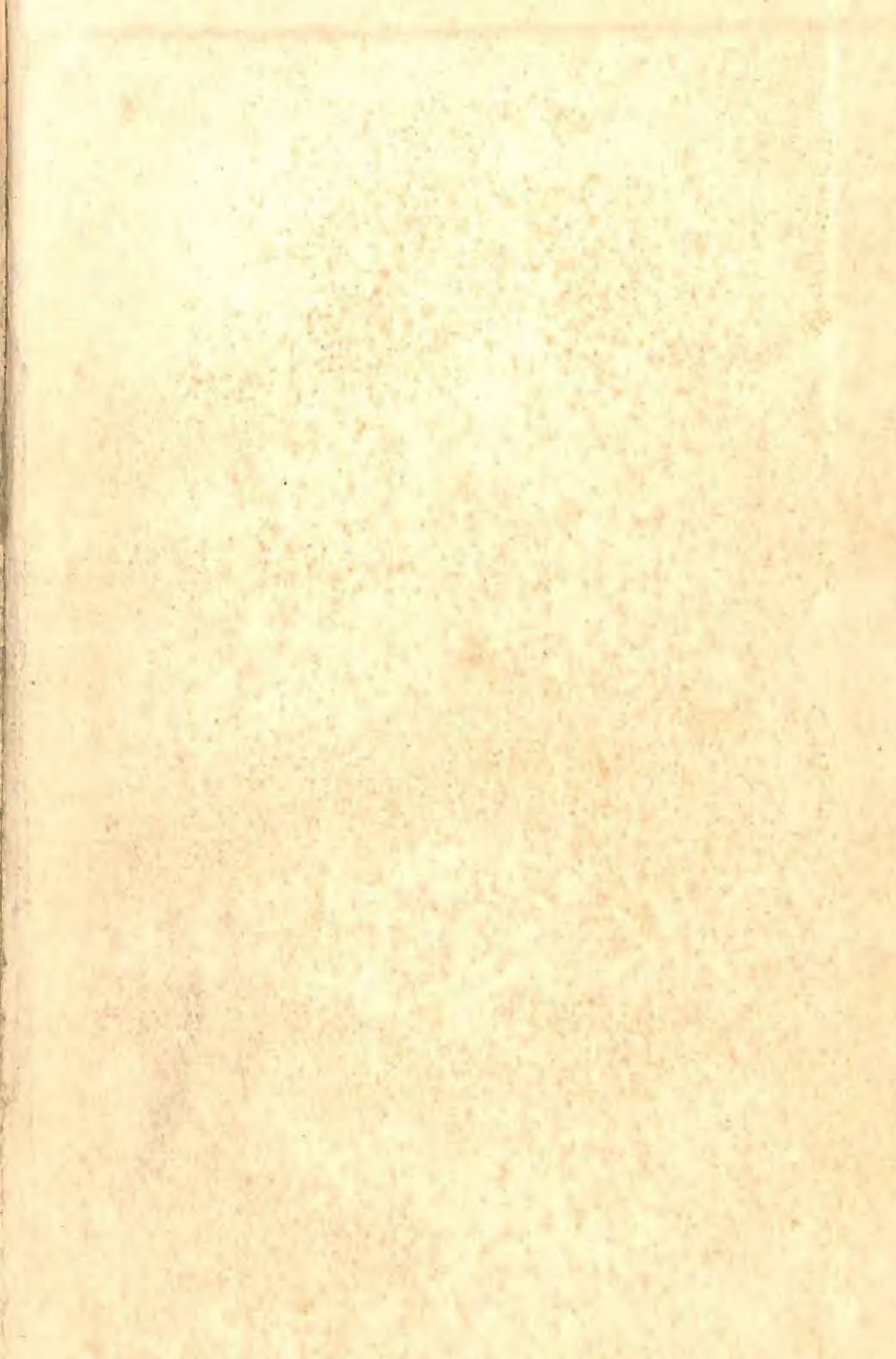
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